BEHIND THE SCENES AT LONDON AIRPORT

Also in this series

BEHIND THE SCENES IN AN OCEAN LINER

In preparation

BEHIND THE SCENES IN AN OILFIELD
BEHIND THE SCENES IN A HOSPITAL
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BEHIND THE SCENES IN A COAL MINE
BEHIND THE SCENES ON A NEWSPAPER
BEHIND THE SCENES WITH A FISHING FLEET

General Editor: Norman Wymer

A B.O.A.C. Boeing 707, which can seat 137 passengers.

B.O.A.C. Photograph.

BEHIND THE SCENES

at London Airport

NORMAN WYMER

WITH 44 PHOTOGRAPHS,
A COLOURED FRONTISPIECE
AND LINE DRAWINGS BY
H. A. JOHNS

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By courtesy of Marconi's Wireless Telegraph Company

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By courtesy of B.O.A.C.

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A Comet taxiing past the terminal buildings
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Passengers boarding a Britannia
By courtesy of B.O.A.C.

DRAWINGS

ACKNOWLEDGMENTS

I WISH to acknowledge the great assistance I have received from the Ministry of Aviation, who have given me every facility to study at first hand the workings of the various departments of London Airport. In the Control Tower, for example, the various systems of control were explained to me during operations; and I was allowed to watch the Controllers at work, to follow the progress of the aircraft on the radar screen, and to listen through headphones to the replies of the pilots to the Controllers' instructions. The Telecommunications Section, responsible for the equipment, kindly supplied me with material, much of it hitherto unpublished, about their department. The Ministry of Aviation have also checked the manuscript for accuracy.

I am greatly indebted, too, to British Overseas Airways Corporation, British European Airways, many foreign airline companies—notably Pan American World Airways and Trans World Airlines—Vickers Armstrongs, the de Havilland Aircraft Company, Bristol Aircraft, Boeing International Corporation, Rolls-Royce, Marconi's Wireless Telegraph Company, H.M. Customs and Excise, the General Post Office, Shell-Mex and B.P., and other organizations who have supplied information or answered queries. I should like to express especial thanks to B.O.A.C. and Vickers-Armstrongs. B.O.A.C. supplied me with a wealth of material about their routes and operational methods and gave me facilities to inspect their various departments at London Airport. Vickers-Armstrongs likewise assisted me with the chapters relating to the airliners and the air crew.

I am also grateful to the above-mentioned organizations who have supplied photographs.

Finally, I wish to express my thanks to individual pilots and air stewardesses who have given me valuable information based on personal experience.

CHAPTER

1

The World's Premier International Airport

BETWEEN five hundred and six hundred airliners fly into or out of London Airport every day, the number varying according to the weather conditions and the season of the year. Every two or three minutes, in the peak periods, an airliner roars down one of the five runways, carrying anything up to 150 passengers to some near or distant foreign land. As, with gathering speed, she soars into the air and fades from sight, so another airliner descends the glide path and lands on a different runway at the end of her journey from some other part of the world. And from time to time freight liners also land or take off.

At all hours of the day and night a large array of aircraft of the principal airlines of the world, over fifty of which regularly use London Airport, are parked on the concrete 'aprons' by the main passenger buildings in readiness for flight. Side by side with the aircraft of the two British State airlines, British Overseas Airways Corporation (B.O.A.C.) and British European Airways (B.E.A.), as many as twenty or thirty foreign airliners, each bearing the distinctive code sign of her nationality, may be drawn up at any one time—airliners from France, Italy, Germany, Switzerland, and indeed from almost any country in

Western Europe; from Canada, the United States, or South America; from Africa and the Middle East; from Australia and the Far East, including jet airliners from Japan, India, and Pakistan; and from countries behind the Iron Curtain, including Russia, Poland, Czechoslovakia, and Hungary.

In the old days of the sailing ships, Britain's geographical position as a link between the Old World and the New made her a great maritime nation. Today, in the Jet Age, her geography gives her the same importance in the air. London Airport is like the hub of a wheel whose spokes radiate in all directions over the surface of the earth. London Airport spans the world. Day and night, when weather conditions permit, the air corridors leading into and out of the airport hum with the powerful engines of arriving and departing aircraft. London Airport, though not the largest, is the premier *international* airport of the world, handling a greater volume of international passengers than that of the four New York airports combined.

Yet the building and development of London Airport has all taken place since the Second World War. Before the war, most of the four and a quarter square miles of Hounslow Heath now occupied by the airport comprised market gardens, small farms, and deserted gravel pits.

Hounslow Heath, which lies some fourteen miles to the west of Charing Cross, was also associated with travel in the days of the stagecoach. During the eighteenth century—the heyday of the coach—the heath, then a desolate waste straddling the Bath Road, was infested by desperate and violent highwaymen, who held up coaches at the point of the pistol and robbed the fashionable lords and ladies on their way to 'take the waters' at Bath. Many a highwayman was subsequently hounded down, tried, sentenced, and then hanged from a gibbet on the heath as a warning to others. But still the coaches were waylaid. Travellers on the Bath Road—now streaming with motor traffic—crossed

the lonely, dangerous heath, the most dreaded district near London, at their peril.

However, after the enclosure of the commons in the early nineteenth century, mounted police began to patrol the heath, rounding up the highwaymen and raiding the lonely cottages and public houses harbouring criminals, one of these inns being The Three Magpies, now near the main entrance to the airport. Gradually the district became safer, until, by the early years of Queen Victoria's reign, about five hundred stage coaches were passing daily through the toll gates and turnpikes on Hounslow Heath—approximately the same number as the airliners now using London Airport on an average day.

It was a few months after the end of the First World War that the first aircraft took off from the heath. Early one morning in August 1919 a converted de Havilland bomber, built of wood and canvas, jolted precariously across a bumpy field, rose into the air with a deafening roar, and then winged her way southwards towards the English Channel on a flight to Paris. She carried one passenger in the draughty compartment behind the lone pilot, and her 'cargo' comprised some bundles of newspapers, a few bales of leather, three or four brace of grouse, and a dozen or so jars of Devonshire cream. This uncomfortable flight inaugurated the world's first international commercial air service. But the bumpy fields of Heathrow, as this area of Hounslow Heath is called, were not then considered a suitable site for a permanent international airport. London's first airport was built at Croydon. It was opened the following year, 1920, and it became the terminal for many an historic flight during the exciting years of aviation history between the two world wars.

During the Second World War, when London was subjected to ruthless aerial bombardment by the German Luftwaffe, the terminal was transferred to Hurn, near Bournemouth.

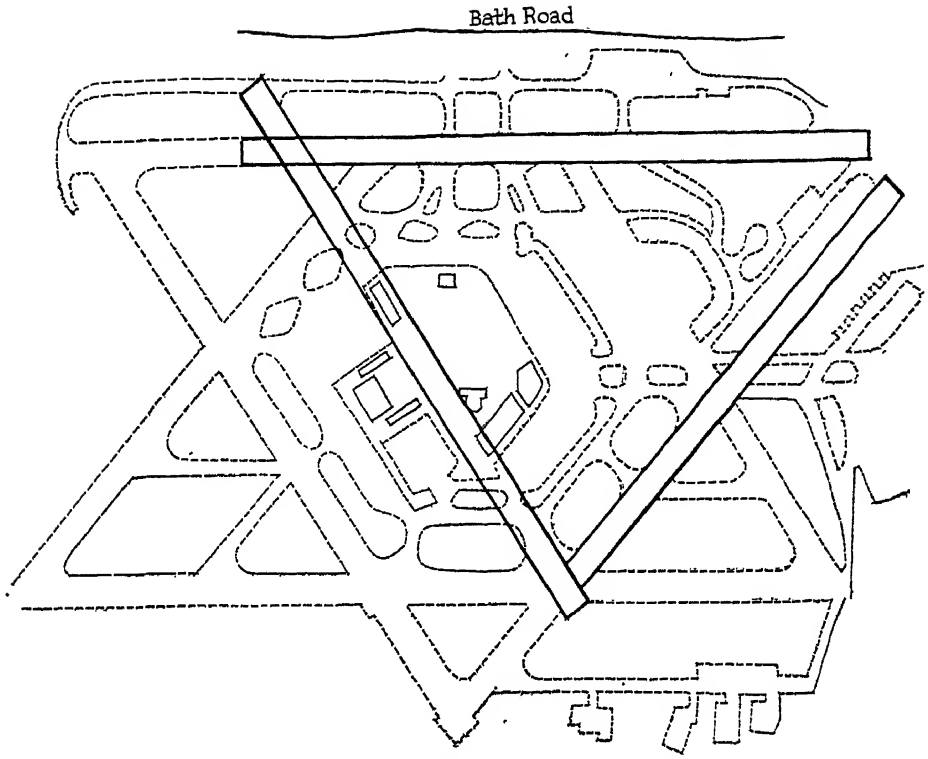
The R.A.F. were really responsible for the birth of London

Airport. A year or so before the end of the war the R.A.F. began to build an aerodrome at Heathrow, three or four miles from the spot where the aeroplane of 1919 had inaugurated the first commercial air service. They laid down a triangle of three runways and erected a number of temporary buildings; but, before the structural operations were completed, the war came to a sudden end with the unexpectedly early surrender of the Japanese, and the new airfield was no longer required. The Ministry of Aviation, foreseeing that the many wartime developments in aircraft design and construction would quickly lead to a rapid and constant expansion in air travel, immediately took over the airfield, which had never been used, and began to develop it into a civil airport—London (Heathrow) Airport.

The first passenger flight from the new airport was made on 1 June 1946. A British and two American airlines were the first to operate regularly from the airport; but very soon they were joined by other companies. These airlines had to operate in the most primitive conditions, the aerodrome consisting simply of the triangle of runways and the sheds erected by the R.A.F. There were no permanent buildings: no proper control tower, no quarters for the airport staff, no comfortable waiting-rooms for the passengers, no adequate facilities of any kind. The single-storey wooden buildings were adapted for passenger handling; and the other departments, including Customs and Immigration, were housed in caravans and draughty marquees, through which the wind whistled in winter.

Yet, in spite of all these inconveniences and discomforts, London Airport developed in only four years, by 1950, into the busiest airport in Europe.

The construction and equipment of the airport was a stupendous task. The initial preparation of the airfield involved diverting two rivers, one of which had been cut on the orders of Charles II to feed the fountains at Hampton Court and the



The original triangle of runways seen against the background of the star-shaped pattern at London Airport today.

other by the Duke of Northumberland to provide a waterway for barges to reach his mill on Hounslow Heath, where he manufactured gunpowder during the Napoleonic wars.

The laying of the runways, taxiways, and perimeter road was also a major feat of civil engineering. The triangle of runways laid down by the R.A.F. being inadequate, it was decided to redesign the layout to form a star-shaped pattern of six runways. Before work could begin on this, numerous flooded gravel-pits, covering some eighty acres of this area, had to be drained and filled with top-soil—a task involving the excavation of some ten million cubic yards of earth. Gravel from the outlying pits then

had to be excavated and transported to provide the foundations for the runways. Over these foundations concrete was laid to a thickness of twenty inches to give a bearing strength of 4,000 pounds per square inch. The need for such strength can be judged from the fact that a modern airliner, which may weigh anything up to 150 tons, touches down on a runway at a speed of about 140 miles an hour.

It is estimated that the amount of concrete used in the construction of the runways, taxiways, and roads of London Airport would have been sufficient to build a trunk road from London to Edinburgh, a distance of about 375 miles.

During the course of these operations the plan was modified slightly: it was decided to limit the number of runways to five and to convert one of the six into a taxiway. The pattern now in use thus includes a single runway and two pairs of parallel runways, running in different directions, thereby allowing two airliners to land or take off simultaneously against the wind, from whichever direction the wind may be blowing.

In view of the vast areas of impermeable concrete, reservoirs and some 110 miles of storm-water sewers then had to be built to regulate the flow of rain-water from the runways and taxiways and carry it into the River Thames.

With great foresight and originality, the planners of London Airport decided to concentrate the main terminal buildings—control tower, administrative offices, and passenger buildings—in a large diamond-shaped space in the centre of the runways, taxiways, and aprons. This presented another major task: the provision of a means of access to the central terminal area without crossing the runways.

The only solution to this problem was to build a tunnel from the main entrance to the airport, by the Bath Road. But this could not be built in the conventional way because of the shallowness of the bore. So the engineers had to rip up part of

Number One runway and its adjacent taxiways and excavate a trench about thirty feet deep and nearly half a mile long. In this trench they built a reinforced concrete shell, eighty-six feet wide and twenty-three feet high, and then subdivided this internally into two dual carriage-ways, one for inbound and the other for outbound traffic, flanking each carriage-way with a cycle track and a footpath for pedestrians. Around and above this shell the engineers compacted tons of gravel, and then relaid the runway and aprons overhead.

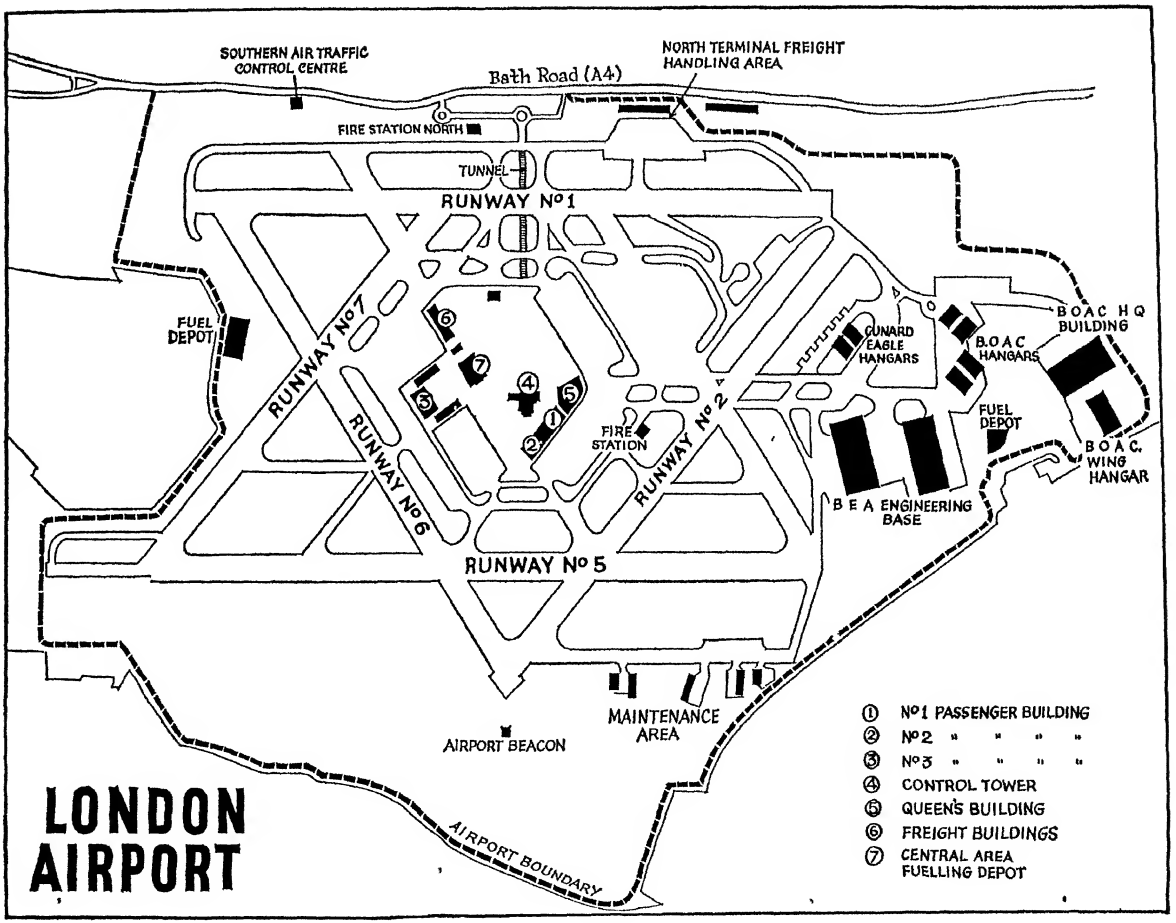
This tunnel, scientifically ventilated and lighted, can carry two thousand vehicles an hour—including double-decker buses —in each direction.

The engineers also had to cut a number of vehicle subways to the marshalling aprons, where the aircraft load and unload their passengers and cargo. In addition to all this, they had to criss-cross the airfield with over seven hundred miles of underground electric cabling to carry the current—essential to every department of the airport—from some forty substations.

The tasks were so many and so great that it was not until 1952, when the airport had been in operation for six years, that work began on the construction of the central terminal buildings. This unit, which took ten years to complete, comprises: the Control Building, Queen's Building, 'Short-haul' Passenger Buildings Nos. 1 and 2, and 'Long-haul' Passenger Building No. 3.

The Control Building, with its famous nine-storey tower rising to a height of 127 feet, is the nerve centre of the airport. From this building highly trained teams of Controllers, on duty day and night, control the movement of aircraft, both in the air and on the ground, and of all land vehicles—ambulances, fire-engines, police-cars, and tenders—by means of radar and the most modern electronic and telecommunications equipment.

Queen's Building houses the airline offices, where flights are


SOUTHERN AIR TRAFFIC CONTROL CENTRE
Bath Road (A4)
NORTH TERMINAL FREIGHT HANDLING AREA
FIRE STATION NORTH
TUNNEL
RUNWAY No 1
FUEL DEPOT
RUNWAY No 7
RUNWAY No 6
RUNWAY No 2
RUNWAY No 5
FIRE STATION
CUNARD EAGLE HANGARS
B.O.A.C HANGARS
B.O.A.C HQ BUILDING
FUEL DEPOT
B.O.A.C. WING HANGAR
B.E.A ENGINEERING BASE
MAINTENANCE AREA
AIRPORT BEACON
AIRPORT BOUNDARY
LONDON AIRPORT
① No 1 PASSENGER BUILDING
② No 2 " " " "
③ No 3 " " " "
④ CONTROL TOWER
⑤ QUEEN'S BUILDING
⑥ FREIGHT BUILDINGS
⑦ CENTRAL AREA FUELLING DEPOT

planned and crews briefed; the highly important Meteorological Office which supplies the pilots with the weather reports and forecasts; press conference rooms where travellers in the public eye—royalty, diplomats, politicians, film stars, and other V.I.P.s—are interviewed for radio and television; a post office; a canteen for the staff and a restaurant and various other amenities for the general public. Above Queen's Building are the popular Roof Gardens from which the general public can watch the various activities on the airfield. Hundreds of thousands, sometimes more than a million, people of all ages visit London Airport each year to take advantage of these facilities.

The 'Short-haul' Building, opened in 1955, is for passenger traffic to and from Europe, and the 'Long-haul' Building, opened in 1962, for long-distance passenger traffic. Both these buildings are splendidly appointed, containing the most modern amenities for the convenience and comfort of the passengers—shops, banks for the exchange of currency, post and cable offices, restaurant and lounges, hairdressing saloons, and nursery suites with trained nurses to look after and entertain children of all nationalities, especially unaccompanied children, during the waiting period before a flight. Each building is equipped with 'endless-belt' baggage conveyors, which carry passengers' luggage through to the 'Airside' of the building, where it is transported to the aircraft and stowed in the hold. During this procedure the passengers, after passing through the Immigration and Customs controls, wait in the comfortable lounges, where refreshments, magazines, and a wide variety of goods can be bought.

The 'Long-haul' Building—which, with the adjoining office blocks, cost about £3,500,000—will have another improvement: a series of covered corridors are being built, leading from the building to the adjoining apron, which will enable passengers to

board the aircraft without exposing themselves to the weather. The apron can accommodate over twenty of the world's largest jet airliners at a time; and it is possible to handle a thousand passengers an hour in this building.

The idea of concentrating the terminal buildings in the centre of the airfield—original to London Airport—has proved so economical in space that this plan has since been adopted, with variations, by other airports in several parts of the world.

And all this has developed from a few wooden buildings, caravans, and marquees.

The development has not been confined to the central area. To the east of the runways there are the enormous hangars and workshops of B.O.A.C. and B.E.A., the two principal airlines operating from London Airport. Various other buildings—one being the Skyport telephone exchange—are dotted around the perimeter; and the airfield is studded with radio, radar, and telecommunications equipment.

Over £35,000,000 went into the construction and equipment of London Airport during the first fifteen years. Every year a further £1,000,000 or more is spent on extensions and improvements.

The increase in air travel since the Second World War has been so great that it has even been necessary to develop a second airport—Gatwick—as a subsidiary to London Airport. The first airport in the world to combine air, main line rail, and road transport facilities in one unit, Gatwick has become a base for most independent British airlines and for many foreign airlines; it also serves as a diversion airport when London Airport is blanketed in fog and unable to operate.

The growth of London Airport, where between 30,000 and 35,000 people are now employed, has been phenomenal. In 1946, its first year in operation, the passenger traffic was about 63,000. Fifteen years later, in 1961, it topped 6,000,000. It is

expected that in 1970 the figure will reach 12,000,000 or 13,000,000—more than double the number. At the same time freight traffic has been rising at an equally impressive rate.

In the eighteenth century, when the highwaymen held up the coaches on Hounslow Heath, it took travellers three days to reach Bath—and they considered themselves lucky to arrive at all. Today travellers taking off from this same heath can fly round the world in that time, and in greater safety.

And it was only at the beginning of this century, in 1903, that the Wright brothers built the first aeroplane.

CHAPTER

2

Conquest of the Air

THE first British engineer to design and construct an aircraft was A. V. Roe, and the first to go into commercial production Frederick Handley Page.

In 1907 Roe, who had no capital, rented a shed on the old motor-racing track at Brooklands, near Weybridge; and, in this cramped and inconvenient workshop, he worked at his drawing-board or bench for long hours each day and then dossed down in a corner for the night so as to be on the spot to resume his labours at dawn. When he was hungry he would cook himself a kipper or some rashers of bacon, or nibble dates: he could spare neither the time nor money for proper meals. After working in these miserable conditions for more than a year, Roe finally produced a light aeroplane that was to bring him fame—the forerunner of the famous Avro aircraft of today.

A year or so later, in 1909, Handley Page, better placed financially, formed a private company with a capital of £10,000, bought some old sheds and a piece of rough ground at Barking, and, with these as his workshops and airfield, started Britain's first aircraft factory.

During the next five years others now equally famous also entered the field of aviation, notably the Short brothers,

Geoffrey de Havilland, and Vickers, who opened a factory at Weybridge and a flying school at Brooklands, the scene of Roe's labours. At the same time the firm of Rolls-Royce—inspired by Charles Rolls, an enthusiastic aviator who unhappily crashed to his death in 1910—began to turn their attention to the design of an aero engine. By the outbreak of the First World War, in 1914, many of the principal British firms now engaged in the construction of powerful streamlined airliners for British and foreign airlines had started production.

The military needs of war brought revolutionary technical developments. Before the war the maximum speed of the most powerful aeroplane was 126 miles an hour, and its longest duration of flight three hours—carrying only two people. Yet, long before the end of the war, the R.A.F. were ranging over Germany in twin-engined bombers capable of a sustained flight of 800 miles at 100 miles an hour, carrying a load of bombs to the weight of 2,000 pounds.

After the war some of these bombers were converted for civil air transport. As we have seen, it was a converted bomber that inaugurated the world's first commercial air service on Hounslow Heath in 1919. But this was only a stop-gap arrangement. The following year, 1920, Britain's first airliner was brought into service on this route to Paris. It could carry only eight passengers, and the pilot still sat in an open cockpit. Nevertheless it was a beginning. During the next few years more airliners, each with a slightly greater seating capacity, were brought into service. Then, in 1930, Handley Page scored a triumph by producing a four-engined airliner—the Heracles—capable of carrying forty passengers. Meanwhile progress was also being made in other countries, notably in America, France, and Germany.

As the airliners gradually increased in size, carrying capacity, range, and engine power, so airline companies were established

in many countries to operate regular passenger and freight services.

In England, Imperial Airways was founded with Government subsidy in 1924. This company—Britain's first State airline and one of the forerunners of B.O.A.C.—started with only eighteen aircraft, five of which were almost unserviceable, and for the first three years it had to limit its services to Europe. But during the next fifteen years Imperial Airways pioneered a network of long-distance air routes linking England with the countries of the British Commonwealth.

In this giant task they were assisted by a young airman named Alan Cobham who, in the 1920's, made a series of daring flights to chart the best routes for the airliners and find suitable landing-places. Cobham flew round the entire continent of Africa, to India, and to Australia; and on each flight he made a careful survey of air currents and storm tracks and of the reaction of his aircraft to temperature and climatic changes. He also made a detailed geographical survey of each route. On his return from Australia—a flight of 28,000 miles—Cobham was knighted for his services.

During those years between the wars several other brave and adventurous pilots—women as well as men—risked their lives to prove the almost limitless possibilities of air travel. Alcock and Brown, who in 1919, against almost impossible odds, made the first non-stop flight across the Atlantic in an aeroplane that today would not be allowed to take to the air; the Americans Charles Lindbergh and Amelia Earhart, each of whom later flew the Atlantic solo; Amy Johnson, a typist from Hull, who flew solo to Australia among many memorable flights; James Mollison whom she married; Jean Batten; the Australian pilot Kingsford Smith—these and others all played their part in opening the air routes of the world and paving the way for the Jet Age of our day.

By 1939, when the Second World War broke out, Imperial Airways were operating regular services to Europe, the Middle East, India, Burma, Siam, Singapore, Hong Kong, Australia, and Africa. Their aircraft were flying 24,000 miles a day, or 8,750,000 miles a year, on European and trunk services over about 27,000 miles of routes.

In 1939 British Overseas Airways Corporation was formed and subsequently took over Imperial Airways and British Airways. Seven years later, in 1946—the year that London Airport came into operation—the second British State airline, British European Airways, was established to take over the European division of B.O.A.C.

Since the Second World War the technical developments in aircraft design and construction, culminating in the jet airliner, and the spread of the air routes across the world by the British and foreign airline companies have been as rapid and dramatic as the growth of London Airport, to and from which they radiate.

CHAPTER

3

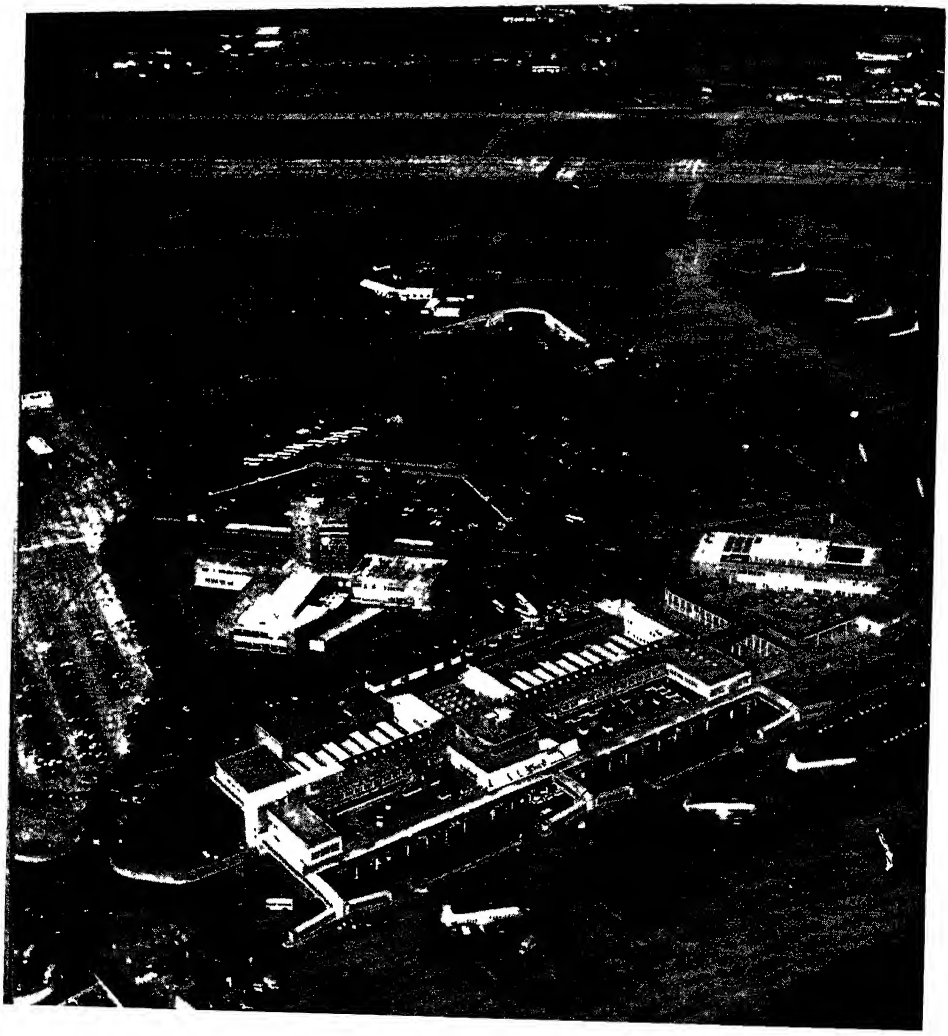
On the Ground

THIS ceaseless activity in the air naturally demands superb organization on the ground on the part of the airport staff, the airline companies, Customs and Immigration authorities, and indeed of every department. Every one of those 30,000 to 35,000 men and women engaged in administrative, maintenance, or operational duties must execute the smallest job with the closest attention to detail and the utmost efficiency, never forgetting that one small mistake, if not detected, can lead to confusion.

London Airport is like a self-contained town, providing most of its own services: telephone exchange, fire service, and police force. The annual consumption of electricity from over forty sub-stations and 700 miles of cables is about 50,000,000 units—almost as much as the electricity consumed by the neighbouring town of Hayes, whose population is approximately 70,000. The airport's fire service has a complement of nearly 100, and is equipped with two foam tenders, nine other mobile fire-fighting appliances, two boats for rescue work on the nearby reservoirs, and two ambulances. On an average the fire brigade answers about 3,000 calls within the airport boundaries in a year. The airport's police force, the Civil Aviation Constabulary, which includes a large motorized section, comprises a uniformed

Passengers disembarking from a B.E.A. Vanguard airliner.

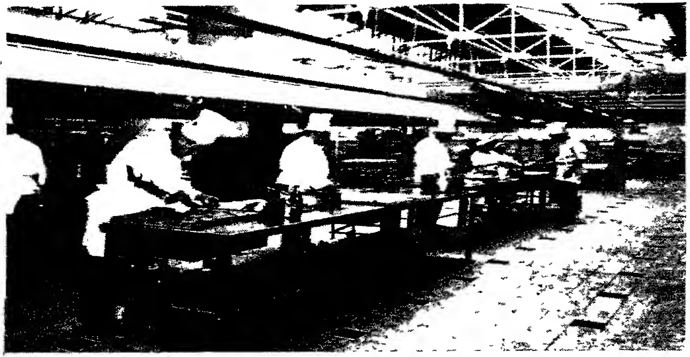
The busiest airport in Europe: the nine-storey Control Tower and the passenger and administrative buildings. From the Control Tower highly trained teams on duty day and night control the movements of all aircraft (on the ground and in the air), and of all land vehicles based on the airport. Part of runway No. 1 can be seen in the background. (See also diagrams on pages 13 and 16.)

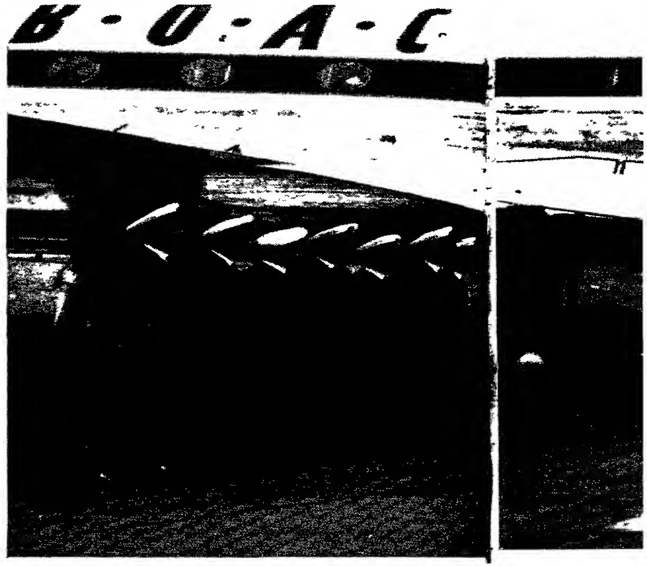


Top : At all hours of the day and night aircraft belonging to the principal airlines of the world are parked on the concrete aprons of London Airport. Here are a B.O.A.C. Comet, a Middle East Airlines Comet, a Qantas Empire Airways Comet, and a Trans-Canada Airlines DC 8.
Below : Supplies being put aboard aircraft about to leave, by Cabin Service vans.

Top: The beginnings of London Airport.
This draughty tent was the passengers' waiting-room
In less than four years the airport was the busiest in Europe.
Below. Laying the runways was a major engineering feat.
A layer of concrete twenty inches thick was put
on the foundations.

The galley on an airliner is tiny but beautifully designed and equipped. Here a steward and stewardess are preparing trays for the passengers.




B·O·A·C

Above: The Queen and the Duke of Edinburgh alighting from a B.O.A.C. Comet 4 jet airliner after an official tour of Canada.

Opposite, top: The kitchens of the B.O.A.C. catering unit at London Airport. *Middle:* Trainee stewards and stewardesses learning to carve a turkey. *Below:* Passengers being served with lunch in a B.E.A. Viscount.

Top : A B.O.A.C. Comet 4 jet airliner taking off from London Airport. *Below :* A B.O.A.C. VC 10 in flight.

branch of 160, a C.I.D. branch of twelve under a separate superintendent, and four air navigation investigation officers: when special security measures are required, as at the time of a royal flight, the Metropolitan Police co-operate with the Civil Aviation Constabulary.

The General Manager, who lives on the airport, is responsible for the general administration of the airport and the co-ordination of its many departments; while the Commandant is in charge of air operations. Like the captain of a ship, the Commandant has command of all flying activities and, though he plays no active part in their actual supervision, he keeps a watching brief over everything that is happening. His office is in the Control Tower, and he is able to follow the movements of the arriving and departing aircraft.

The actual movement of the aircraft, as of the land vehicles, is controlled by the Air Traffic Controller and his team of specialists (described in Chapter Seven); and behind them is the vitally important Telecommunications Section, whose highly qualified engineers and technicians maintain the radar and mass of electronic equipment without which the airport would be unable to function. These technicians check and re-check every item of equipment down to the smallest screw at regular and frequent intervals, and maintain a constant vigil, day and night, to ensure that nothing goes wrong. The two departments, Air Traffic Control and the Telecommunications Section, are tuned to such a high peak of efficiency that it is virtually impossible for any mechanical defect, however serious, to interrupt operations in the Control Building. Even in the unlikely event of a failure in the main equipment being followed by a failure in the emergency equipment, the controllers would still have the means to bring down their aircraft in complete safety—and without the pilots even being aware that anything was wrong. (See page 63.)

Close and friendly co-operation between the airport staff and the airline companies in their respective duties is, of course, of the highest importance. To help promote these good relations, the London Airport Operators Committee, comprising representatives of all airlines based at the airport, hold regular discussions to consider problems and recommend improvements to the airport management.

The closest co-ordination is necessary in the scheduling of the flights of the various airlines so as to avoid congestion, not only at London Airport, but also along the air routes and at the foreign airports where the airliners will touch down or make their final landing. Traffic jams could build up in the air just as easily as on the roads; and, to prevent this, the arrival and departure times of every airliner radiating to and from London Airport must be carefully dovetailed into a world-wide operational pattern embracing the foreign airports linked with the flights. This task is complicated by the fact that bad weather or some other cause beyond control may at any time seriously upset the schedule.

The flights are planned many months in advance; and passages in the airliners are booked by comprehensive systems involving electronic computers and international radio communication. By means of radio, a traveller can book a seat in an airliner from anywhere in the world; and, if he wishes, he can then alter or extend his travel arrangements when he is actually in the air. If, for example, a business man flying from New York to London should suddenly decide, on approaching London, to fly on to France after completing his business in England, he can request the captain or radio officer, through a steward or stewardess, to radio a reservation in a B.E.A. or Air France airliner bound for Paris on a given date.

An international radio communications system, from ground to air and between airports, allows the airline companies to keep

track of their aircraft on their journeys across the globe. Every day the signals centre of B.O.A.C. receives or transmits some 38,000 signals between London Airport and aerodromes, large and small, scattered throughout the world. A high proportion of these messages—sent or received at the rate of one every four seconds—deals with the reservation of seats, but the rest are concerned with the flight of the aircraft.

Some of the messages announce the departure of the airliners bound for London from stations thousands of miles away, from as far afield as Hong Kong, Sydney, or Calcutta. Further signals will later be received from the landing-places at which these airliners refuel; and from these reports their progress across the world is plotted on wall charts in the airline offices. Other messages give warning of engineering needs, so that special arrangements can be made with the engineers in the maintenance workshops for overhauling the airliner in question as soon as she reaches London Airport. This advance notice may save valuable hours in the 'turn-round' before the airliner's next journey.

Messages between far-distant countries are transmitted through a network of radio channels by a highly complex mechanical process. For example, a message from London to Bangkok, in Thailand, is carried by landline from the signals centre to a G.P.O. transmitter, which automatically passes it on to a relay station in the Aden Desert. There the message is fed, without any help from a human operator, into a radio channel to Singapore. Thence, through two further channels, it is re-transmitted, first to Hong Kong, and then to Bangkok, where finally it is carried to the airline office by landline.

When aircraft are within a radius of about 250 miles of London Airport, the airline companies, like the Air Traffic Control teams, are able to establish direct radio communications with the pilots. At one time a pilot had to keep a constant

listening watch through his headphones for messages directed to him; but today he is relieved of this burden by an air-to-ground radio telephone system known as Selective Calling, or 'Selcal'. When an airline company or the Air Traffic Controllers call a pilot, a bell on the flight deck of his aircraft, and of his alone, rings—in the same way as telephone calls on land are made.

B.O.A.C., who control the most extensive radio network of any international airline, spend about £2,000,000 a year—about the price of a jet airliner—on their communications system.

Some companies operating at London Airport employ their own traffic staff to receive and assemble passengers for its various services, check their passports and papers, prepare the documents to be carried by the captain of the aircraft, and attend to the many other formalities and regulations that must be observed before an airliner can take off.

The passengers are conducted on to their aircraft by a receptionist, who remains personally responsible for them until the door of the airliner is closed, when responsibility passes to the captain. If a flight is delayed through bad weather, mechanical trouble, or perhaps because landing conditions at the terminal have been reported as unsuitable, a passenger officer must make provision for the passengers during the waiting period and, if necessary, find them hotel accommodation for the night. Other personnel are likewise responsible for supervising the loading of the freight aircraft, ensuring that the cargo is evenly distributed in the hold and securely battened down, so as to prevent any possible risk of its tossing about in flight and upsetting the balance of the aircraft.

Several thousand men and women, many of whom have high qualifications, are also employed daily in planning, preparing and cooking the meals for the travellers, in kitchens equipped with all the most modern scientific and hygienic appliances.

London Airport caters, through outside firms, for the restaurants in the passenger buildings and for the staff canteens; and the airline companies and other specialist firms produce the meals served in their aircraft. All aim at standards comparable with those of a first-class hotel.

Since the travellers come from every corner of the globe, the caterers must study and satisfy the wide range of taste of the numerous nationalities and the customs and restrictions of their various religions. Care must be taken never to serve a passenger in an airliner with food which his religion forbids him to eat. Moslems, for example, refuse to eat ham; while practising Jews require special 'kosher' food.

The menus in the airliners naturally vary with the different routes. On the Atlantic flights American or British tastes will be catered for primarily; whereas on the routes to India, Pakistan, and the Far East consideration will be given to eastern as well as western tastes. But this is only a broad principle.

Owing to the restricted space in an airliner, all meals are cooked before departure and then re-heated during the journey. The food is prepared, cooked, and deep-frozen in the airport kitchens, scientifically packed in special containers, and then loaded into the aircraft's pantries for the stewards or stewardesses to heat, as and when required, in the ovens of the small but well-designed galleys. Airliners on long-distance journeys are replenished at airports along the route with meals cooked by local caterers.

The kitchens of B.O.A.C.'s catering unit at London Airport are divided into sections—larder, vegetable preparation, butchery, and fish preparation—each of which is under the supervision of a specialist cook. There is also a test kitchen where connoisseurs cook and sample new types of food, compare different brands, balance menus, and also test new catering or cooking equipment.

Some 3,000 meals and a similar quantity of light refreshments are prepared daily for B.O.A.C.'s services from London Airport; and the food, as also the water, is medically inspected before being loaded into the airliners. The catering department also attends to the bar requisites of the airliners, issuing on an average day some 90 bottles of spirits, 200 bottles of wine, 250 cans of beer, 30,000 cigarettes, and 1,000 books, magazines, and newspapers. They are also responsible for the catering and domestic equipment—linen, cutlery, crockery, glassware, soap, and toilet paper—of both the outgoing and the incoming aircraft. As many as 2,500 articles of linen and 26,000 pieces of china and glassware are collected in a single day from the incoming aircraft and then laundered or washed.

The air crews (described in Chapter Six) of the two British State airlines receive part of their training at London Airport, but the foreign air crews are trained in their own countries. B.O.A.C., who have about 13,000 employees at the airport, have a vast training organization covering every department, both operational and administrative. Their 1,200 pilots, flight engineers, and navigators receive their initial training, and then take regular refresher courses at B.O.A.C.'s air training school, just outside the airport's boundaries, which is reputed to be the finest in the world. And the stewards and stewardesses are taught their catering and many other duties in the company's Cabin Services School, near the catering unit.

The same importance is attached to the physical fitness of the air crews as to their training. To ensure that they are always in the prime of health, pilots throughout the world are required by international law to be medically examined at regular intervals. These examinations are conducted at one of the medical centres at London Airport.

The Ministry of Aviation, B.O.A.C., B.E.A., and several of the foreign airlines provide a comprehensive health service at

their respective centres—physiotherapy, all the latest electrical treatments, X-ray, and indeed most of the amenities to be found in a modern hospital, including in some cases a pathology laboratory. B.O.A.C., being the largest company, has as many as five medical units dotted about the airport at strategic points.

One centre caters for passengers as well as employees. Bedrooms are available for anyone who is taken ill, and for invalid travellers who may have to wait several hours between flights. Nursing sisters and medical orderlies are on the spot at all hours to attend to the sick and give first-aid treatment for accidents; and a doctor is always on call. Provision is also made for vaccinating passengers against various dangerous diseases, when this is required.

People travelling to or from certain countries where smallpox, typhoid, cholera, or yellow fever are prevalent must be immunized against these diseases; and it is the responsibility of the airport's Medical Officer of Health to ensure that passengers comply with the regulations.

The medical officer will allow no one to whom these restrictions apply either to embark or disembark unless or until he can produce the required medical certificates of immunization. Indeed, before an incoming airliner from any country can discharge her passengers, the captain must satisfy the medical officer or one of his staff that passengers and crew alike have a clean bill of health. If this is so, the medical officer will give *pratique*, allowing complete freedom of movement; but, if there are any cases of serious infectious disease aboard, he may hold the airliner in isolation, refusing permission for anyone to disembark until the necessary medical precautions have been taken.

Besides obtaining medical *pratique*, passengers and crew must also be 'cleared' by the Immigration and Customs authorities—another large and important department of the airport.

The Immigration officers interrogate all foreign travellers to see if they come within any of the categories of 'undesirable alien' legally precluded from entry into Britain. They must ascertain whether an alien is wanted in his own country for any crime which may demand his return under international law—that is, his extradition—or if he has a criminal record; whether he is suffering from any form of mental disorder or serious chronic disease; and whether he is able to support himself financially or has relatives in the country to support him. They will question him closely about his reasons for coming to Britain—whether he has come to do business or take up employment, or is paying a social visit to see the sights or stay with relations.

If, as in most cases, the foreigner passes his interrogation, and his credentials and documents are in order, he will be allowed to land. If, as sometimes happens, the foreigner appears to be of good character but is unable to satisfy the immigration officer on every point, the immigration officer may exercise discretion and permit him to stay in the country for a limited period. But never on any account will he do this in a criminal or mental case. If he even suspects a foreigner of a criminal record, he will arrange for him to be held in custody for further inquiry or order his immediate removal from the country. In serious criminal cases he will seek the co-operation of Scotland Yard.

The Customs officers have many responsibilities, the chief of which are to assess and collect all duties payable on articles bought abroad, and to prevent smuggling. As soon as an airliner lands, preventive officers board her, take account of the unused dutiable stores—wines, spirits, cigarettes, and suchlike—and place a Customs seal on the door of the storeroom, the reason for this being that such articles may be sold duty-free only when the airliner is in the air. No one except a Customs officer may break this seal while the aircraft is on the ground: when the

caterers replenish the stocks for the next journey, they must do this in his presence.

The preventive officers also 'rummage' the aircraft—search in every possible hiding-place for undeclared dutiable or prohibited goods that may have been concealed by a passenger or member of the crew.

Meanwhile, in the Customs halls of the terminal buildings, other Customs officers examine the baggage of the passengers and crew and assess and collect the duties on the articles they declare. If they suspect a passenger of not making a full declaration, they will open and search his baggage for dutiable articles —a watch, a bottle of perfume, or some other 'bargain'—hidden in an article of clothing.

The Customs control of the freight airliners is perhaps even more rigorous. An officer known as a landing officer controls and watches the landing of the cargo, and then holds it in official custody until such items as he deems necessary have been examined and cleared by the Customs inspectors.

The watch against smuggling never ceases. Day and night, waterguard officers—who take their name from the officers on similar duty at the shipping ports—maintain a constant patrol of the tarmac, on the look-out for suspicious activities.

Another vital department of London Airport is the Meteorological Office, whose weather forecasts—based on the reports of ships, aircraft, radio shore stations, and observation posts all over the world—govern all air tactics.

The vice-president of the American Air Line Pilots Association has described London Airport as being, operationally, 'as close to Utopia as you can get from a pilot's viewpoint'. It is this vast ground staff—these thousands of men and women working behind the scenes in their various departments as one great team—who have built this Utopia.

CHAPTER

4

Airlines and Airliners

THE British State and private airline companies operate their various routes under licence from the Air Transport Licensing Board; and the foreign airlines receive licences from similar organizations in their respective countries. But the nations do not exercise complete independence in their air transport arrangements. To avoid congestion in the air and uneconomic duplication of services, the routes of their airlines are integrated by international agreement into a world-wide pattern.

Like road vehicles, all civil aircraft must be registered, and display in two prominent positions the code letters of their nationality, followed by a further series of letters or numbers indicating their airline company, so that they will be immediately identifiable as they fly from country to country. The following table denotes the national code signs of the countries whose airliners may be seen on the aprons and taxiways at London Airport:

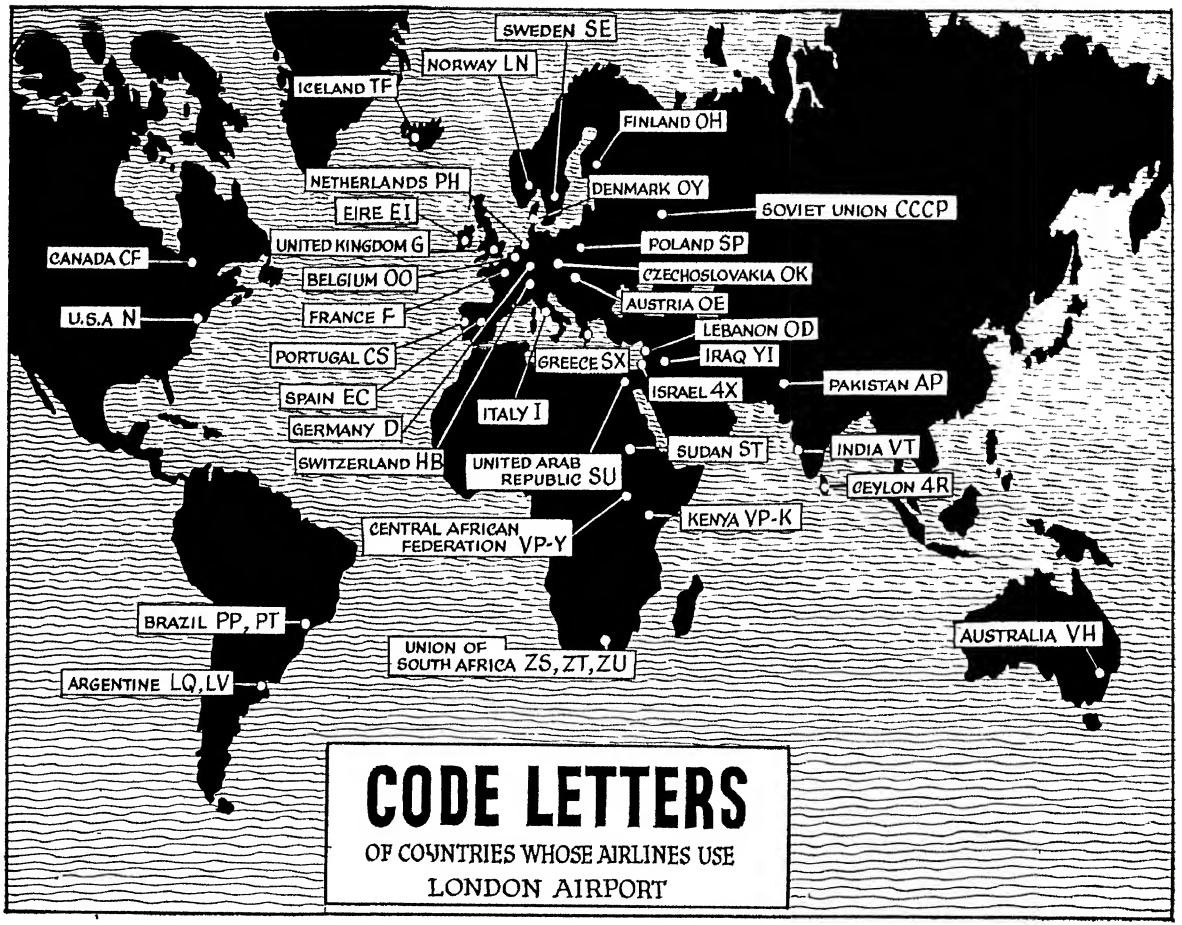
AP	= Pakistan	EC	= Spain
CCCP	= Soviet Union	EI	= Eire
CF	= Canada	F	= France
CS	= Portugal	G	= United Kingdom
D	= Germany	HB	= Switzerland

I	= Italy	SU	= United Arab Rep. (Egypt)
LN	= Norway	SX	= Greece
LQ, LV	= Argentine	TF	= Iceland
N	= United States of America	VH	= Australia
OD	= Lebanon	VP-K	= Kenya
OE	= Austria	VP-Y	= Central African Federation
OH	= Finland	VT	= India
OK	= Czechoslovakia	YI	= Iraq
OO	= Belgium	ZS, ZT, ZU	= Union of South Africa
OY	= Denmark	4R	= Ceylon
PH	= Netherlands	4X	= Israel
PP, PT	= Brazil	9G	= Ghana
SE	= Sweden		
SP	= Poland		
ST	= Sudan		

Some countries have more than one airline operating at London Airport. The United States, for instance, are represented by Pan American World Airways and Trans World Airlines. And, of course, Britain's two State airlines, B.O.A.C. and B.E.A., operate all their principal services from this base.

B.O.A.C. operate long-distance services to all six continents, serving the major towns and cities of nearly sixty countries. Their services include flights to New York in seven hours and thirty-five minutes and to Australia in thirty hours, and three weekly flights round the world, one of which takes in Rome, Istanbul, Teheran, Bombay, Colombo, Singapore, Hong Kong, Tokyo, Honolulu, San Francisco, and New York. At peak periods B.O.A.C. operate about 110 return services weekly. During the course of a year their aircraft cover well over 70,000,000 miles.

B.E.A. serve all the principal cities of Europe, their busiest routes to the Continent being those from London to Paris, Nice,


SWEDEN SE
NORWAY LN
ICELAND TF
FINLAND OH
NETHERLANDS PH
DENMARK OY
EIRE EI
SOVIET UNION CCCP
UNITED KINGDOM G
POLAND SP
CANADA CF
CZECHOSLOVAKIA OK
BELGIUM OO
AUSTRIA OE
U.S.A N
FRANCE F
LEBANON OD
IRAQ YI
PORTUGAL CS
GREECE SX
PAKISTAN AP
ISRAEL 4X
SPAIN EC
ITALY I
INDIA VT
GERMANY D
SUDAN ST
SWITZERLAND HB
UNITED ARAB REPUBLIC SU
CEYLON 4R
KENYA VP-K
CENTRAL AFRICAN FEDERATION VP-Y
BRAZIL PP, PT
AUSTRALIA VH
UNION OF SOUTH AFRICA ZS, ZT, ZU
ARGENTINE LQ, LV
CODE LETTERS
OF COUNTRIES WHOSE AIRLINES USE
LONDON AIRPORT

Brussels, Amsterdam, Düsseldorf, and Zürich. Their airliners range over both sides of the Iron Curtain, their services to the Communist countries including a flight of 1,600 miles in three and a half hours to Moscow.

In addition to their regular services, both B.O.A.C. and B.E.A. arrange special charter flights for travel agencies, business organizations, football teams, and for various other groups of people who, from time to time, request these arrangements. And it is in their airliners that the Queen and other members of the royal family travel on their many journeys abroad. When the Queen pays a state visit to a European capital she nearly always flies in a B.E.A. airliner; likewise, when she visits one of the countries of the British Commonwealth, or some other country farther afield, she usually makes the journey in an aircraft of B.O.A.C.

When a royal visit is planned, elaborate preparations are made by the airport management and the airline company concerned. The aircraft selected for the journey is mechanically overhauled by highly qualified engineers; and its interior is stripped and refurnished in an elegant but simple style with easy chairs, tables, pile carpets, warm curtains, and other comforts. For a long-distance flight the cabin is divided into two suites, each with divan beds: one suite is occupied by the Queen and the Duke of Edinburgh, if he is accompanying her, and the other suite by the Queen's official party. While the aircraft is being prepared, the air crew is carefully selected; and the captain and his officers are briefed for their heavy responsibilities. The caterers prepare the menus for the journey in consultation with the Royal Household at Buckingham Palace, detail the best cooks to prepare the meals, and issue special instructions to the stewards and stewardesses who will serve them. Meanwhile, special police security arrangements and other preparations for the Queen's reception at the airport are made.

Finally, on the day of the flight, the airliner, whose cabin is decorated with flowers, is drawn by tractor on to the tarmac in front of the private suite in the passenger building, also rich with flowers. Polished steps, reserved only for royalty, are placed by the entrance to the airliner; and a red carpet is laid from the lounge to these steps. Accompanied by members of the royal family, cabinet ministers, and others, the Queen walks slowly along the red carpet, between lines of photographers and reporters, mounts the steps, turns and waves to the crowd of spectators, and enters the airliner. The engines start up; and at the exact minute appointed the aircraft taxies away to the end of the runway, sweeps along the concrete strip, rises into the sky, and disappears from sight.

Though B.O.A.C. and B.E.A. handle by far the largest volume of both passenger and freight traffic, more than fifty foreign airline companies, as already mentioned, are also based at London Airport. Pan American World Airways and Trans World Airlines operate frequent daily transatlantic flights between London and New York; Trans-Canada Airlines radiate to the major cities of Canada; and other airlines to the countries of Central and South America.

The principal European airlines include K.L.M. Royal Dutch Airlines, established in 1919, the year of the first commercial flight from London; Air France, who operate ten daily services between London and Paris; Alitalia, whose European network embraces the whole of the Mediterranean and North Africa; Swissair, whose principal routes from London are to Zürich, Basle, and Geneva; the Austrian Airlines, who run a daily service between London and Vienna; the Iberia Airlines of Spain, Sabena of Belgium, Finnair of Finland, the Lufthansa German Airlines, and the Scandinavian Airline System of Norway, Denmark, and Sweden.

The foreign airlines linking London with the continent of

Africa include Central African Airways, United Arab Airlines, Middle East Airlines, South African Airways, Nigerian Airways, and Ghana Airways. London is linked with the major cities of Australia by Qantas Empire Airways of Sydney, who, like B.O.A.C., operate a weekly service round the world; and the countries of the Far East are linked by Air India International, who run daily services between London and Bombay, and by Pakistan International Airlines, who operate daily between London and Karachi.

The airliners of these and the many other companies not mentioned can all be identified by the code letters and numbers on their wings or fuselage as they parade on the aprons of London Airport in readiness for flight. (See pages 34–5, 36.)

At one time all aircraft were driven by piston engines; but a large number of the airliners now in service have either jet-prop or pure jet engines. And the number is increasing every year. The jet-prop or turbo-prop has propellers driven by turbines and is a compromise between the old piston engines—which will soon be obsolete—and the pure jet engine which has no propellers.

The basic principle of the jet-prop is that air is swallowed by the engine in vast quantities, compressed, sprayed with fuel, and ignited. The hot gas produced by continuous combustion is channelled in a constant flow into either one or two turbines which drive the compressor and the propellers. After passing through the turbines the gas escapes through the exhaust pipe and in so doing gives an extra thrust to the aircraft. In the pure jet engine an immense volume of air is drawn in at the front, compressed, fed into combustion chambers, mixed with fuel vapour, and ignited. The hot gas is then directed into the turbines—which again drive the compressor—and from there it passes into the jet pipe, where it expands and builds up a driving power of many thousands of pounds that thrusts the

aircraft forward like a rocket. As fresh gases flow into the jet pipe the stale gases are expelled with tremendous velocity.

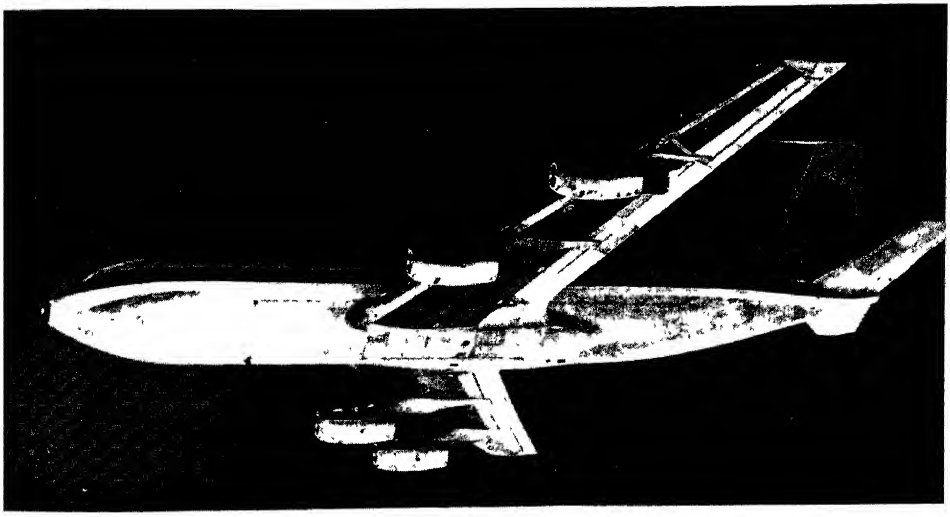
At take-off each of the four engines with which a jet airliner is powered sucks in some four to five tons of air and consumes about eighteen gallons of fuel a minute. The engines expel their gases at a speed of about 1,500 miles an hour; and the powerful thrust allows the aircraft to fly straight off the runway into a steep climb and, when fully airborne, to develop and maintain a steady speed of anything up to 600 miles an hour. The higher a jet airliner flies, the better, smoother, and more economical her performance.

The operational costs of a jet airliner are extremely high, the fuel consumption of a pure jet being twice as great as that of a jet-prop: the four Rolls-Royce Avon engines of a Comet cruising at about 500 miles an hour consume as much as 1,000 gallons of fuel an hour. But these costs are offset by the extra size of the jet airliner, allowing the carriage of many more passengers and, by the extra speed, reducing the duration of the flights. The only drawback is the noise of the engines which, though almost silent to the traveller, are deafening to people living in the vicinity of London Airport. The aircraft manufacturers are making constant tests and experiments to overcome this problem. Meanwhile screens, baffles, and high earthbanks have been erected at the airport to reduce the noise on the ground when the jet engines are running up.

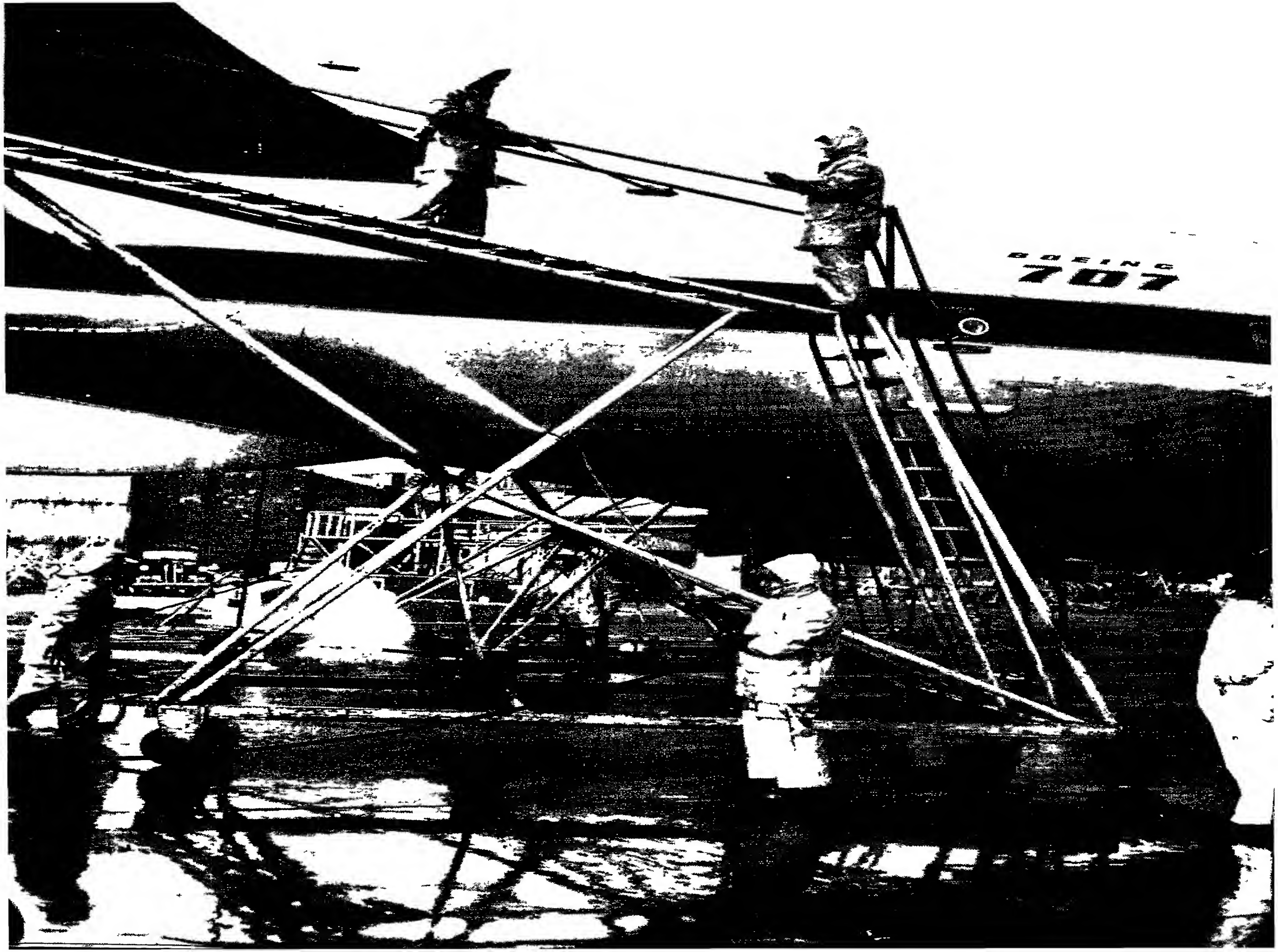
B.O.A.C. was the first airline to operate a pure jet airliner, and B.E.A. the first to operate a turbo-prop airliner. In 1952 B.O.A.C. introduced the famous pure jet de Havilland Comet into regular passenger service between London and Johannesburg; and in 1953 B.E.A. brought into service the equally famous turbo-prop Vickers Viscount.

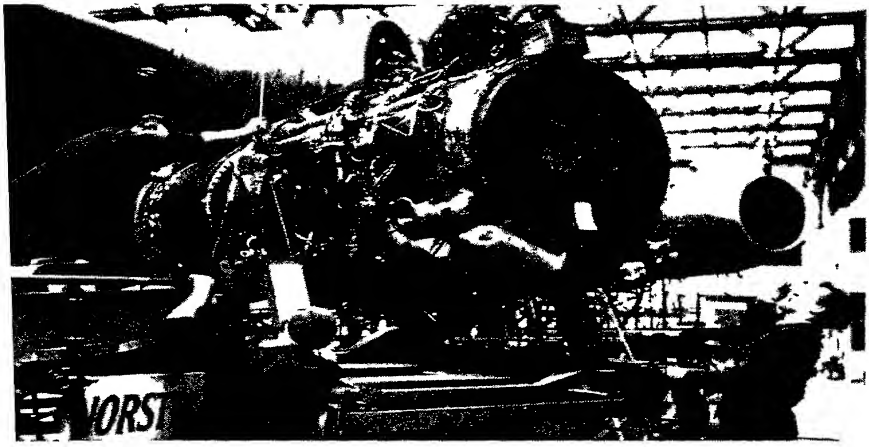
The Comet survived serious teething troubles and today is flown by many companies operating at London Airport. There are now a number of different designs of pure jet airliner: the

A B.E.A. Argosy taking off.



A Boeing 707 of Pan American World Airways.

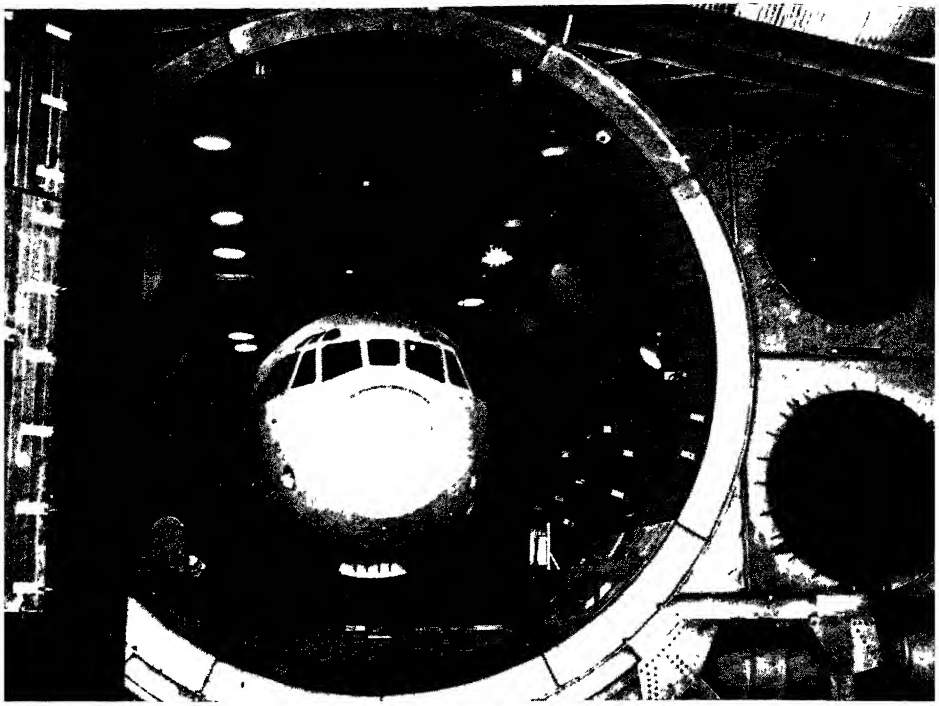

BOEING
707



Above, top : A Rolls-Royce Avon for the de Havilland Comet about to be taken to the test beds at the Rolls-Royce factory.

In the hangars and workshops at London Airport, which are among the largest and best equipped in the world, airliners and their components are maintained, overhauled, and repaired. *Below*: A Boeing's engine is changed over in one of the hangars.

Opposite : A B.O.A.C. Boeing 707 being washed down with a chemical spray by men in protective clothing.

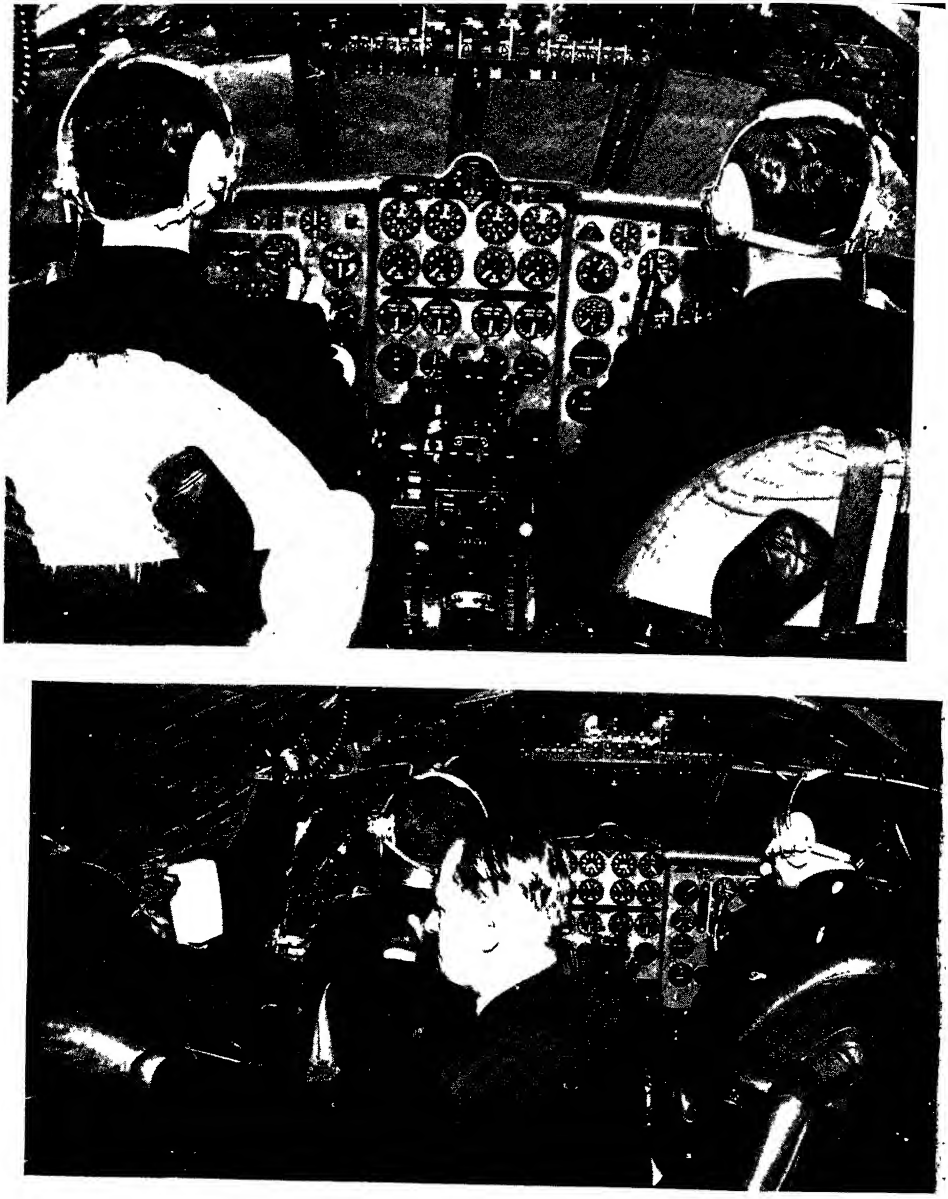


Above: A VC 10 in the Strato chamber at Weybridge, where it can be tested under high altitude conditions.
Right: General maintenance on a Comet 4 jet airliner.

Well over 100,000 tons of freight pass through London's airport every year, and include many kinds of animals.
Left: Young elephants arriving from Bangkok.
Below: Boxes of baby chicks being loaded.

Right: Freight is packed in containers of many different shapes and sizes, which must be scientifically stored to obtain the right 'trim'. *Below:* Some of the several hundred million letters and parcels which every year go by airmail from the G.P.O.

Left : A mock-up of a passenger cabin with girls training to be stewardesses, some playing the part of the travellers. *Below :* A Pakistani trainee serves a group of Chinese and English students.



Top : The captain and his co-pilot at their stations on the flight deck in the nose of the aircraft.
Below : Pilots undergo part of their training in electronically powered simulators, exact working reproductions of the cockpit of an aircraft.

Comet, the Trident (also built by the de Havilland Aircraft Company), and the Vickers VC10; the American Boeing 707, the Convair 880 and 990, and the Douglas DC-8; the French Caravelle; and the Russian Tupolev TU 104. The VC10, coming into service in 1964, is 158 feet long with a wing span of 140 feet; and her four Rolls-Royce Conway engines can develop almost twice the thrust of those of the Comet. The Convair 990, with a cruising speed of over 600 miles an hour, is the fastest jet airliner, while the largest is the Boeing 707, which has a range of over 5,000 miles but a slightly lower cruising speed.

The construction of an aircraft capable of these performances —or indeed of any modern airliner—is an enormous and highly skilled operation, involving perhaps 10,000 men, and occupying anything from two years for an established model to ten years for a new design. Every British airliner—whether piston, jet-prop, or pure jet—must be built and equipped to certain specifications laid down by the Air Registration Board, designed to promote the highest degree of airworthiness and the maximum safety for passengers and crew in all conditions.

An aircraft must be equipped with radio and radio aids to navigation, a compass, and certain basic 'blind-flying' instruments, which generally comprise an air-speed indicator, an altimeter, an indicator showing the rate of climb or descent, a 'turn and slip' indicator to show the pilot whether he is turning correctly, and a periscopic sextant to show him the altitude of his aircraft. Even birds sometimes lose their sense of direction in clouds. This ingenious periscopic sextant is inserted in the roof of the flight deck. But these are only the basic requirements. All airliners carry a battery of instruments: in the Boeing 707 the captain and first officer, or co-pilot, have a panel of some thirty-seven instruments to read, while the engineer and navigating officers also have a large number.

There must also, of course, be an automatic pilot: 'George',

as it is called. The captain always handles the controls when taking off or landing, but for the greater part of the journey an airliner, like a ship, is piloted mechanically.

Regulations are likewise laid down to protect the airliner against the hazards of weather. Her frame must be designed to withstand the strains and stresses of a thunderstorm, which in some parts of the world, notably the tropics, can be very violent and alarming. To reduce the risk of being struck by lightning, every section of the airframe is bonded to the next with copper wire; and small brushes are fixed to the trailing edges of wings and control surfaces to carry off static discharge. If an airliner should be struck by lightning the noise will be terrific; but, though she may lose her aerials and have a channel gouged out of her tail, she will still be airworthy and perfectly safe.

Another serious weather hazard is the formation of ice in clouds below freezing level, on such places as the edges and hinges of wings, rudder, propeller blades, the air intakes of the engines, and the aerials. The formation of ice on any of the control surfaces could cause serious trouble, while ice on the aerials might prevent the transmission or reception of radio messages. All the vulnerable parts must therefore be protected by some form of de-icing equipment.

The storm turbulence builds up in the clouds: above the clouds the weather is usually calm. An aircraft flying at a high altitude—at, say, 25,000 feet or above—can normally travel, on the same fuel consumption, faster and farther than an aircraft at a lower altitude. The great height to which the jet airliners can climb is one of the main contributing factors to their splendid performance. But the pressure and density of the air at these heights is so low that it is necessary to pressurize the interior of the aircraft to enable the passengers and crew to breathe freely. At whatever height the aircraft may be flying the air in the cabin and on the flight deck is maintained

mechanically at a pressure corresponding to that at about 8,000 feet. This pressurization imposes an immense strain on the hull of the aircraft, the weight against the doors being about six or seven tons. The aircraft has to be especially strengthened to withstand this strain; and the doors are fitted with huge bolts of high tensile steel and edged with large tubes which inflate during pressurization, thereby forming a seal.

The numerous safety regulations also control the overall load—passengers, crew, fuel, and cargo—that an aircraft may 'lift'. Reliable weather reports and forecasts must be regularly radioed to the captain during a flight. Finally, every airliner on a flight over water must be provided with life-jackets and rubber dinghies, in case the pilot should run into serious trouble and be obliged to 'ditch' his aircraft in the sea.

Before a new airliner is brought into service she is subjected to long and rigorous tests, both on the ground and in the air. The many and lengthy tests on the Comet included immersion of the fuselage in a giant water-tank, where the structure was tested under pressure against the loads of take-off, landing, and flight for the equivalent of thirty-three years of normal operation. At regular intervals detailed inspections were made for the smallest signs of a flaw or weakness. When every section of the aircraft had passed inspection the Comet was given numerous equally stringent tests in actual flight.

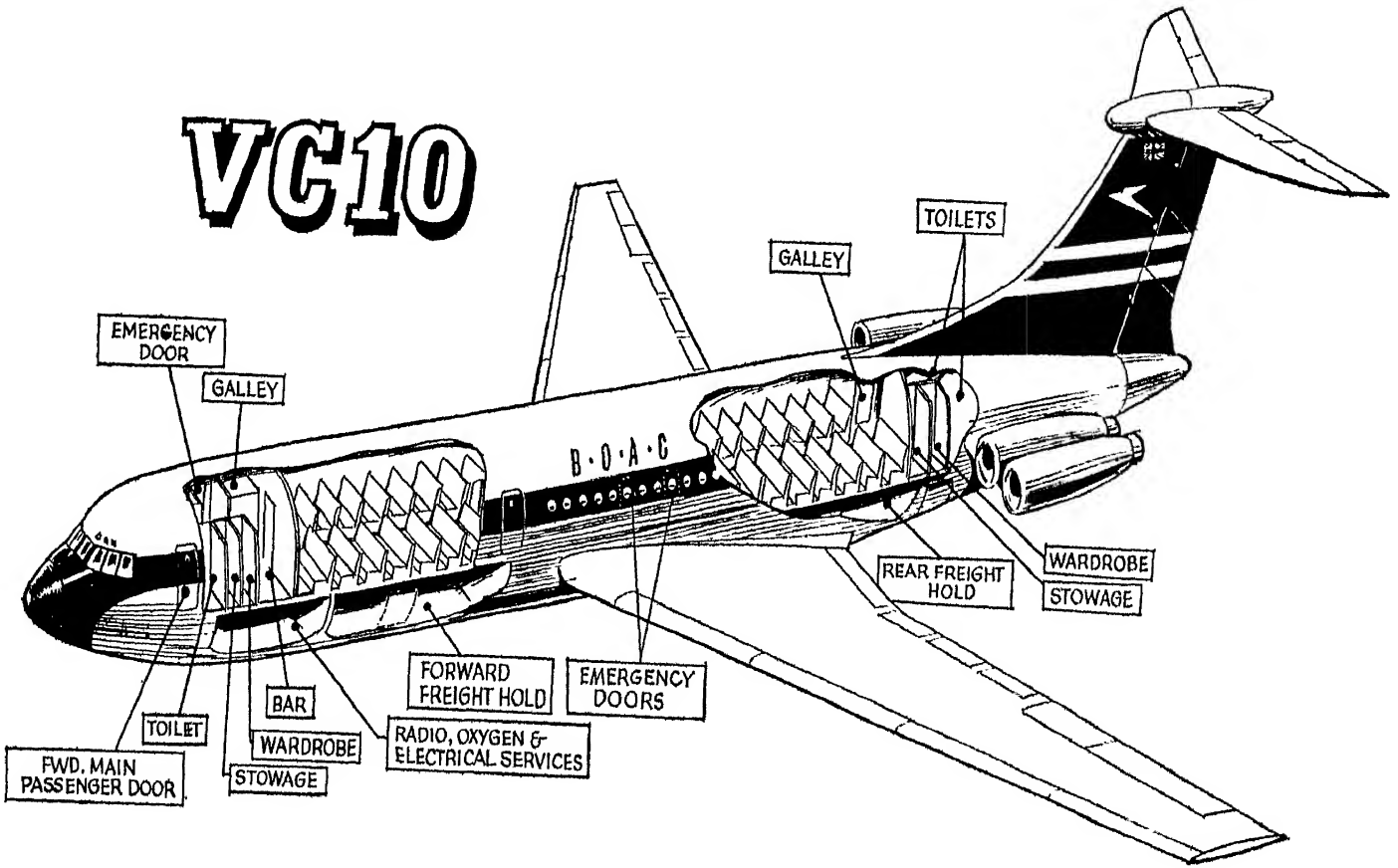
Neither time nor money is spared in testing an airliner. Though figures have not been published, it is estimated that Vickers will eventually have spent between £25,000,000 and £50,000,000 on developing the VC10. During the tests on the VC10, instruments totalling about fifteen tons in weight took readings of the engines and structure from nearly 2,500 different points, while three television cameras photographed the tail, fuselage, and undercarriage. The tests on the Trident are said to have cost about £6 a minute.

The same high standards of safety and performance must be maintained through all the years that an airliner is in service. This, of course, is the responsibility of the airline companies. The British State airlines and a number of the foreign airlines have maintenance workshops at London Airport. The workshops and hangars of B.O.A.C. and B.E.A. are among the largest and best equipped in the world. B.E.A.'s engineering base cost about £2,000,000.

At both these bases several hundred men are daily engaged in examining, testing, and repairing the thousands of components of the modern airliner. Travelling cranes carry engines, undercarriage assemblies, and other heavy parts from one inspection point to the next. X-ray units are available to seek out cracks or other weaknesses behind the trim and upholstery. And in special air-conditioned rooms, free of dust, skilled technicians service delicate precision instruments and radio equipment. B.E.A. estimate that for an aircraft such as the Viscount six man-hours of base maintenance work are required for each hour of flying.

A complex set of records of every aircraft in service is compiled to ensure that nothing shall escape the searching eyes of the engineers and inspectors. In addition to the routine maintenance, a series of checks is carried out at set intervals, based on the number of hours the aircraft has flown. Once a year the airliner is almost completely dismantled, when every single component is checked and, if necessary, replaced. Vickers state that their VC10 and Vanguard are designed to fly for 30,000 hours before any section of the structure needs replacing for fatigue reasons. Other airliners are likewise designed for long trouble-free service. Even so, they are all subjected to the most rigorous inspection annually.

No airliner ever takes the air until the inspectors are absolutely satisfied that every section, every instrument, is in perfect repair.


VC10
EMERGENCY DOOR
GALLEY
GALLEY
TOILETS
B·O·A·C
REAR FREIGHT HOLD
WARDROBE
STOWAGE
FORWARD FREIGHT HOLD
EMERGENCY DOORS
BAR
TOILET
WARDROBE
STOWAGE
RADIO, OXYGEN & ELECTRICAL SERVICES
FWD. MAIN PASSENGER DOOR

CHAPTER

5

Freight and Mail

MOST passenger airliners carry a quantity of cargo in their holds, while many of the large airline companies also operate special freight aircraft.

Freight aeroplanes range from the small Twin Pioneer and DC3, which lift 3,550 pounds and 5,380 pounds respectively, to giants such as the Canadair CL-44D-4, which carries 64,915 pounds over 3,550 nautical miles. On the Canadair the complete rear fuselage, including fin- and tail-plane, can swing open to expose the fuselage cross-section. The cargo is then loaded into the 'tube' that is the fuselage. The Canadair and the Armstrong-Whitworth Argosy are the only two freighters in service that were specially designed to carry cargo. Most freight carriers have been converted from passenger airliners: some aircraft serve a dual purpose, carrying passengers on one journey and freight on the next. Soon another type of freight aircraft, the Lockheed 300, will be brought into service: this will contain clam-shell doors and a ramp at the back of the fuselage to enable vehicles to drive in.

The machinery for handling freight at London Airport is divided into two departments—Export Cargo and Import Cargo—each of which contains several sections. The various

companies employ their own freight staff; but, though their methods may vary in detail, all arrange their shipments in basically the same way.

In the Export Department, the Reception Section receive the consignments from the shippers or their agents and prepare the shipment documents. Each package is then numbered and labelled, and stowed on one of a large series of racks, apportioned to different parts of the world. The shipment documents are passed on to the Customs Entry Section, whose responsibility is to fill in the Customs forms and make arrangements for Customs 'clearance' of the shipments. They, in turn, pass on the documents to the Charging Section, who prepare the consignment notes and assess the transport charges.

These formalities completed, the next stage is to make up the cargo loads for the various air routes and individual aircraft—a task involving three more teams. The Freight Allocation Section compile lists of shipments for the various foreign destinations. The Manifesting Section apportion the consignments to the company's relevant air services. And Service Control of Load Control decree the weight of cargo each aircraft may carry in conformity with the safety regulations, the load being governed by the number of passengers travelling and the weight of their baggage (in the case of a passenger airliner), by the amount of mail carried, and by the volume of fuel required for the journey.

On receipt of the freight figure from Service Control, the Manifesting Section call on the Freight Allocation Section to allocate consignments to this weight, and then prepare a manifest (invoice) of the shipments to be carried and request the Dispatch Section to arrange for their transfer from the warehouse to the aircraft in question.

The cargo is transferred and loaded into most types of aircraft by means of 'fork-lift' trucks. The Argosy has clam-shell doors

at either end of the fuselage, so that incoming freight can be unloaded at one end as the outgoing cargo is loaded at the other. The goods are packed for shipment in various kinds of container, according to the nature of the cargo; and these containers of so many different weights, shapes, and sizes must be scientifically stowed to obtain the right 'trim'. The head loader prepares a statement, showing in which holds the freight and baggage for the various destinations along the route has been stowed; and this statement, together with the rest of the 'ship's papers', is handed to the captain before the aircraft's departure.

As soon as the aircraft has taken off, a signal is radioed to the next airport along the route, informing the authorities of the amount and position of any cargo to be unloaded there. They, in turn, will radio similar information to the next station where the aircraft is scheduled to land; and this process is repeated all along the route until the aircraft reaches its final destination.

The Import Cargo Department receive the consignments from the incoming aircraft, and are responsible for checking, unloading, obtaining Customs 'clearance', and, finally, for arranging for their collection by, or delivery to, the various consignees.

Some of the cargo landed at London Airport is for trans-shipment to other countries. The transfer of these consignments to linking aircraft that will complete the journey is undertaken jointly, under the watchful eye of the Customs officers, by the airlines' Import and Export Cargo Departments.

Well over 100,000 tons of freight pass through London Airport in a year. In the words of B.O.A.C., 'day in and day out, the world's freight industry is flying the produce of the world's commerce around the globe'. The variety of both imports and exports is extensive, ranging from pins to heavy industrial machinery, from fleas to elephants.

The imports include such articles as carpets and tea from India, cameras and precision instruments from Japan and Germany, silks from Bangkok, shirts from Hong Kong, ostrich feathers from Johannesburg, mother-of-pearl from Cyprus, leather goods from Morocco and Italy, gut for tennis rackets from Sydney, humble sausage skins from Teheran and Damascus, and numerous species of livestock from many countries. Tropical birds and fish for aviaries and aquaria; pedigree livestock for farmers; wild animals such as elephants, lions, tigers, bears, monkeys, and baboons for zoos and circuses—these and many other species are transported to London by air.

Occasionally the unloading of the wild animals causes some anxious moments—as in the case of the dangerous baboon from Kenya which broke out of its crate and disappeared. Warnings were immediately issued over the loudspeakers; and police in cars and on foot were rushed in to conduct a search of the airfield. Eventually, after nearly twelve hours, the baboon was cornered by six policemen and shot. Such incidents, however, are rare. Normally all animals are handled by R.S.P.C.A. inspectors, who feed and water them and, if necessary, bed them down for the night in their special Animal Air Hostel on a corner of the airfield. Between 45,000 and 50,000 animals—ranging from domestic horses, dogs, and cats to leopards, crocodiles, and snakes—are cared for annually in this hostel.

The exports include an equally wide variety of goods of British manufacture: cars and other forms of road transport, farm machinery, plant and equipment for the development of industry in backward countries struggling for better living conditions, radio and television sets, electronic instruments, china and glassware, dresses for the fashion houses of the New World, woollen goods, leatherware, various raw materials, and, most important, medical supplies.

Medicines, drugs, vaccines, and radioactive materials—

encased in lead and loaded in the wings of the aircraft—are constantly flown to doctors and hospitals in countries far and wide to help them combat a sudden outbreak of some dreaded and dangerous disease. This is a reciprocal service in which all countries in a position to do so help each other. Supplies of the precious American Salk vaccine for the prevention of poliomyelitis, which in the past paralysed so many healthy people, are regularly flown to London from New York. Thousands of people all over the world owe their lives to the speed of the modern airliner.

The principal airlines of the various countries also carry mail in their passenger airliners. B.O.A.C., B.E.A., and private British airlines, notably British United Airways, carry much of the mail out of the United Kingdom on behalf of the General Post Office; and the leading foreign airlines bring mail into the United Kingdom for their respective postal services. Some countries, however, have not the facilities for this. So these companies, known as 'Flag Carriers', schedule their programmes to meet the postal needs of other countries along their different routes, thereby providing between them an international air-mail service embracing the whole world.

Each company employs a highly skilled staff to handle its air mail. B.O.A.C. and B.E.A. are in daily consultation with the G.P.O., sorting out problems and working out ways of improving efficiency; and at regular intervals they also consult with the foreign postal authorities whose mail they carry. 'One of the main jobs', states B.O.A.C., 'is allocating space for mail on every sector of the routes, to ensure that it is carried in accordance with the requests of all postal administrations.'

Every day at London Airport teams of sorters and checkers work round the clock dealing with the outgoing G.P.O. mail bags. The magnitude of this task can be judged by the fact that the G.P.O.'s air mail in a single year runs into several hundred

million letters, postcards, and light packages, and over one million parcels.

The speed of the air mail, often vital to the business man, is, of course, responsible for this enormous volume of traffic. But, though the mail may leave London Airport in a jet airliner travelling at 500 to 600 miles an hour, its eventual form of delivery may be very different. In some remote parts of the world the letters may be carried from the aircraft by camel, canoe, or even a runner!

CHAPTER

6

Air Crew

THE crew of a passenger airliner is divided into two sections—flight deck and cabin—and the number and composition of the crew are governed by the size and type of aircraft and the policy of the airline company.

On the flight deck, in the nose of the aircraft, there will always be at least two pilots, probably a flight engineer, and possibly a navigating officer. It used to be customary to carry a radio officer, but today one of the pilots generally takes charge of the radio operations. The navigation of the aircraft, in which radio electronic instruments now play an important part, may also be undertaken by a pilot. The cabin staff, responsible for the comfort of the passengers, usually comprises from one to three air hostesses, or stewardesses, and possibly one to three stewards, making a total complement of up to six stewards and stewardesses.

B.E.A. carry three pilots and four cabin staff in their Comets and Vanguards but only two pilots and two stewardesses in their smaller Viscounts. On the other hand, the American company Trans World Airlines carry in their Boeing Super Jets a minimum of three pilots, a navigator and a flight engineer, and a cabin crew of five hostesses and a purser.

The air crews are selected and trained with the greatest care. The pilots, in particular, must be in first-class medical condition, have attained a high standard of education, and possess special qualities of character to fit them for their exacting duties. They must have a high sense of responsibility, an iron nerve, a calm demeanour, and a degree of self-confidence that will prompt quick reactions in an emergency and yet never lead to recklessness. The pilot of today does not regard every flight as an exciting adventure—as many people suppose—but as a perfectly straightforward job, to be executed with cool efficiency. From the beginning of his training to the end of his career he is keenly conscious of his heavy responsibilities, and will never in any circumstances take the smallest risk.

The training of a pilot is lengthy, intensive, and very expensive. Before a pilot can be employed by a British airline company he must first undergo a two years' course of instruction in light aircraft, have a stated number of flying hours to his credit, and obtain various licences from the Ministry of Aviation. Some pilots are recruited from the R.A.F. or Fleet Air Arm, but the majority now receive their initial training either at a private flying school or else at the Government-subsidized College of Air Training at Hamble, in Hampshire.

After making a number of flights as a passenger, a pupil pilot is allowed to take over the controls in mid air to accustom him to the 'feel' of the aircraft. On the first occasion he may handle the controls for only a few minutes, but on each subsequent flight the period will be gradually extended. When he has become proficient in the air he will attempt the more difficult arts of taking off and landing. He will make his first complete flight in control round a circuit of the aerodrome. Later he will fly cross-country to points perhaps fifty or a hundred miles from the aerodrome; then, as he progresses, he may make flights over the sea. The next stage may be to fly by night. Finally,

when he can handle his aircraft with a high degree of safety, he will be instructed in navigation by means of the basic 'blind-flying' instruments.

In addition to his practical flying instruction the pupil will also make a deep study of the theory of flight, aerodynamics, the technicalities of the various types of aircraft and aero engine, the operational methods of the British and foreign airport control centres, radio and radar communication, aviation law, and the economics of aviation.

On completing his training and obtaining the required licences he is qualified to fly light aeroplanes 'for hire or reward', and can apply for a post with a commercial airline company. If he is accepted, and passes his very severe medical examination, he will then undergo a long and rigorous course of instruction in the handling of a commercial airliner at his company's training centre.

The running costs of some of the modern airliners, with their enormous fuel consumption, are as much as £350 an hour—a prohibitive sum for training purposes. So the pilots undergo a part of their training in electronically powered simulators, whose running costs are only about a tenth of that figure. A simulator is an exact working reproduction of the cockpit of a particular type of aircraft. At their training centre at London Airport, B.O.A.C. have simulators representing the Boeing 707, the Comet 4, and the Britannia airliners; and each simulator, which cost about £500,000, is so complicated that it requires a room nearly fifty feet long by fifteen feet wide to house the valves and switches. These remarkable machines can simulate a flight in every detail and in all flying conditions.

At each training bout, which may occupy four or five hours, the simulator is manned by a full crew, comprising at least two pilots, a flight engineer, and possibly a navigator. The crew take up their positions on the flight deck with a carefully

prepared plan for their flight—say, from London Airport across the Atlantic to Idelwild Airport in New York—and instructors in compartments outside the simulator act as the various airport and airways controllers with whom, on a real journey, the crew would be required to establish radio contact at different stages along the route. Every airliner must always be in radio communication with one or more control points on the ground: an aircraft travelling south from London Airport, for example, will tune in, on crossing the English coast, to the control centre in Paris, and then, on leaving the Paris area, switch over to the next control centre, which on some routes will be at Munich, in Germany.

These instructors, besides controlling the simulated flight along the imaginary airways, feed in, by means of switches, various effects representing hazards and sudden emergencies such as might be encountered on an actual flight—the failure of a vital instrument, a breakdown in the pressurization, an outbreak of fire in the aircraft, the dangerous approach of another aircraft or perhaps a severe thunderstorm. In the case of a thunderstorm, the pilot must reduce speed and try to avoid the turbulence by flying round the storm; if he flies into the storm, the simulator, though stationary on the ground, will shiver and crackle. 'The effects', says a pilot, 'are so realistic that you forget that you are on the ground and really imagine yourself to be in the air. When you rev. up the engines the noise and reactions are absolutely correct. And when you "land on the runway" you can even hear the screech of tyres!'

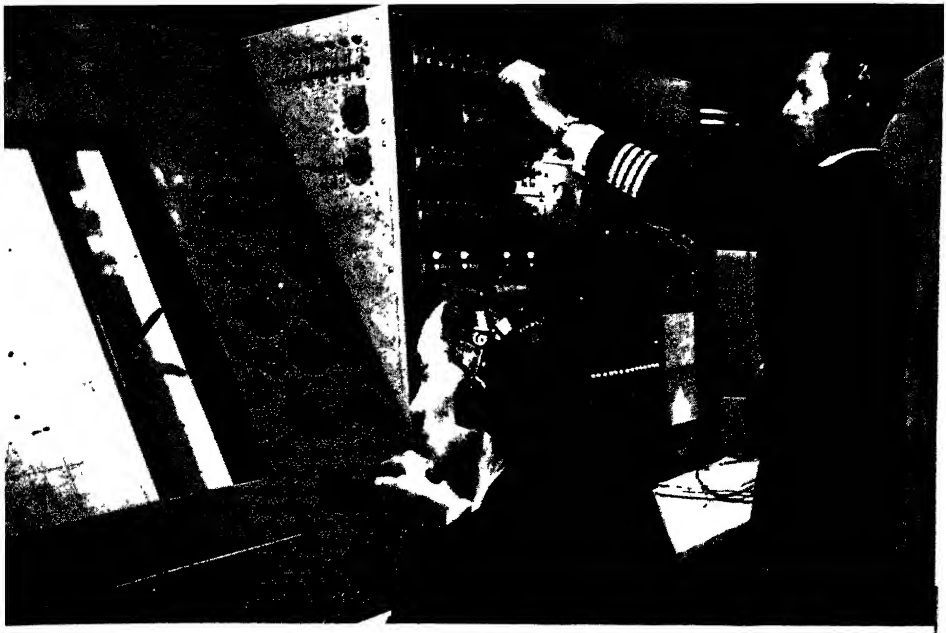
The training in the simulator is followed by a shorter period of instruction in handling the airliner itself. The pilots and navigators also receive intensive instruction in radar and other electronic systems of navigation that are used to supplement the basic navigational instruments.

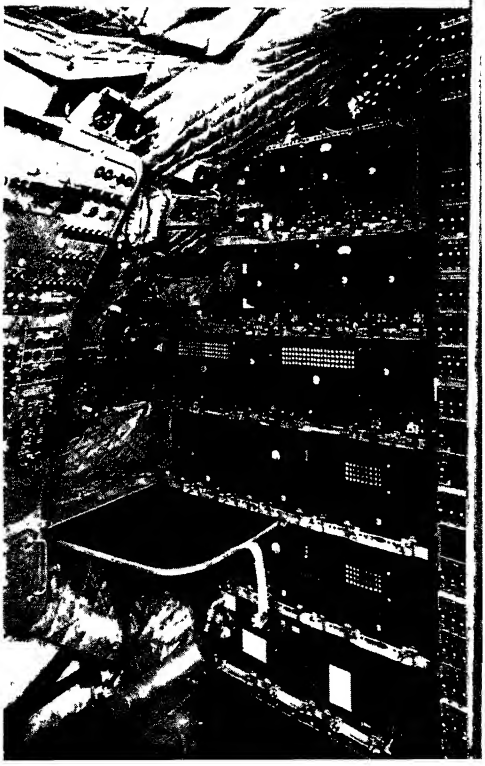
Before the introduction of 'blind-flying' instruments pilots

had to fly most of the time below clouds and guide themselves by following roads and railway lines and trying to pick out prominent landmarks; but today they can navigate their aircraft at any height and for long distances by radio, without sight of land. Besides the control centres, land radio stations—separated along the busy airways at intervals of about five minutes' flying time—transmit radio beams on specified frequencies, each beacon being identifiable by its special note and call sign. As the aircraft approaches a beacon, the captain or first officer tunes in to the signal and takes the bearings by radio compass; and the captain makes any adjustment of course that may be necessary.

There are several electronic systems to assist radio navigation. By means of a distance measuring instrument known as DME (Distance Measuring Equipment) a pilot can tell his distance from a transmitter, and then by means of a second instrument called VOR (Visual Omni-range) assess his direction from the transmitter and direct 'George', the automatic pilot, to 'home' the aircraft towards the signal. When flying over an ocean or desert, where there may be no radio beacons, he can navigate with the same accuracy by a long-range navigation system known as LORAN.

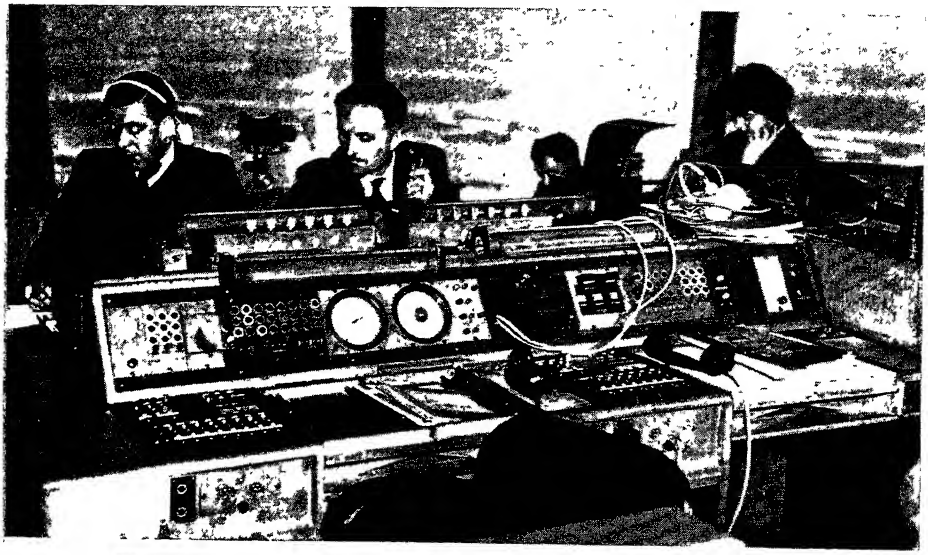
Two other important systems are the Decca Navigator, which automatically traces the course of an aeroplane on a chart; and the Doppler, which measures the amount of drift off track and the speed of the aircraft over the ground, taking into consideration the wind effects. Radar provides warnings of storm clouds up to a distance of about 120 miles, and is also used for surveying the country over which the airliner is flying: if the radar beam is tilted downwards, ground images such as coastline, hills, mountains, rivers, and lakes are reflected on the screen in sufficient detail to allow the navigator to check his position by reference to a map from a height of 20,000 feet or more.

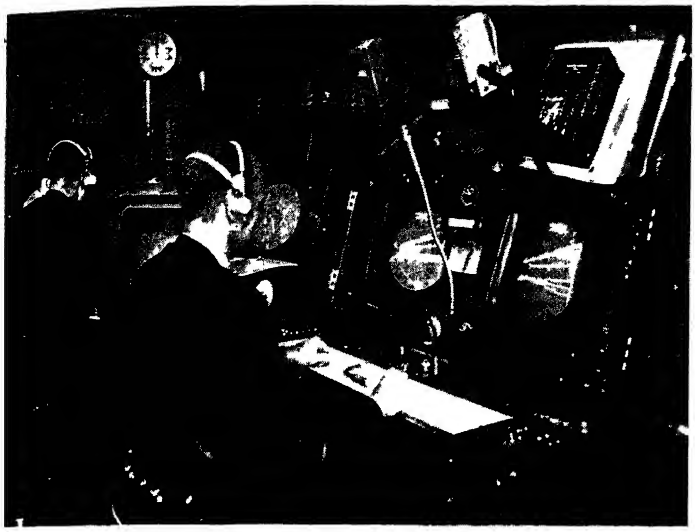


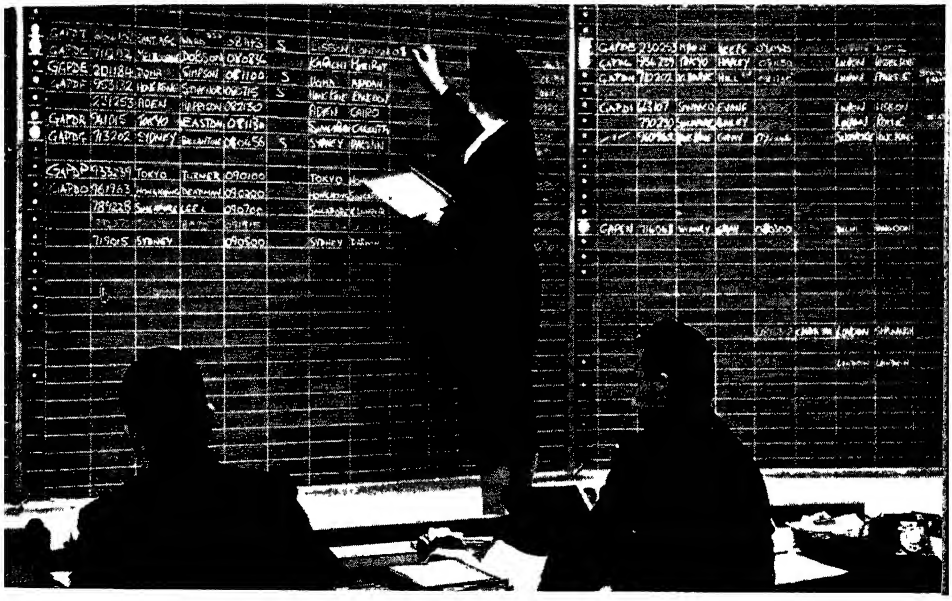


Above: Instructors feeding 'effects' into a simulator. *Right:* The pilot controls an immensely complicated collection of electronic instruments. The radio installation in a de Havilland Comet 4.

Top: In the glass penthouse at the top of the Control Tower, the air controller directs landing and take-off and the ground controller directs incoming aircraft to their parking places. *Below:* The radar controller watches the progress of aircraft on radar screens.

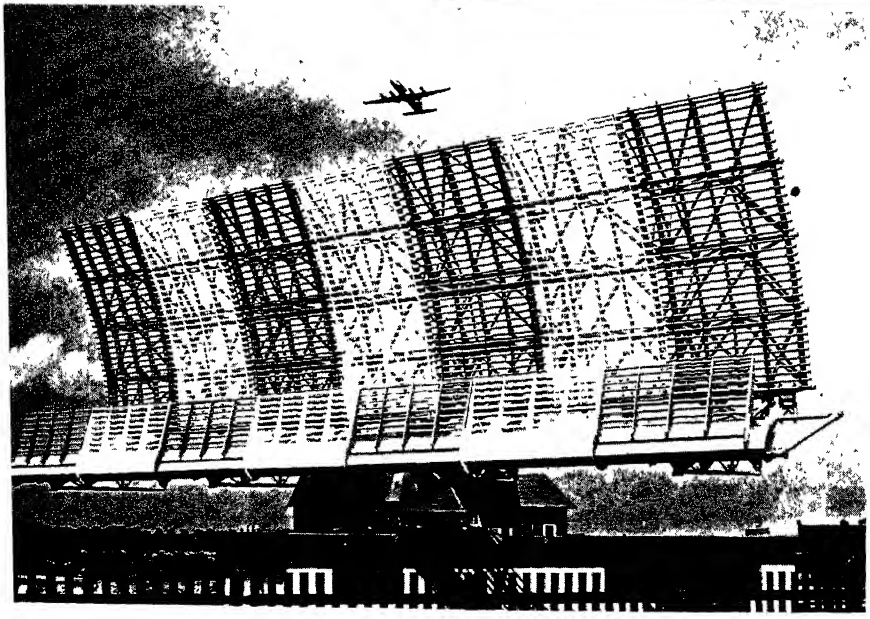


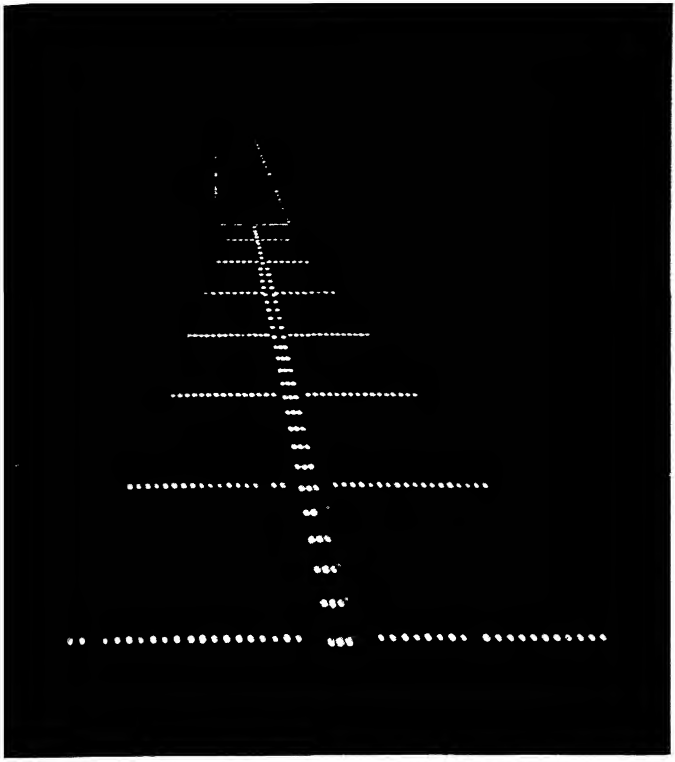




Top : The radar director on the left gives the pilots their final turn on to the instrument landing system, or the precision approach radar controller (*right*) talks them down. *Below :* The position of any airliner, as it proceeds across the world, can be recorded as the result of the information received by radio.

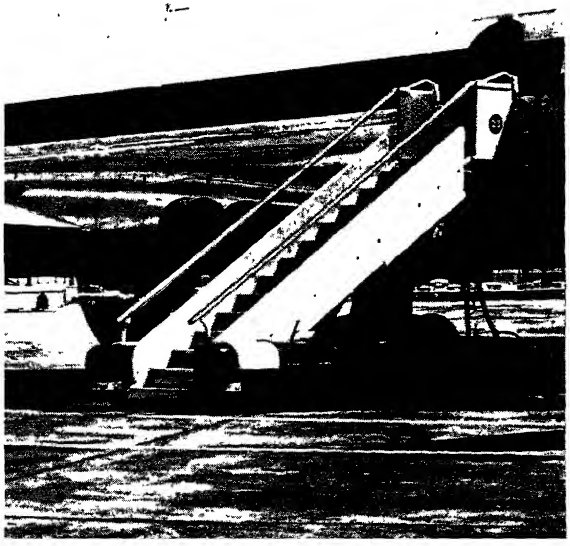
Radar scanners on the airfield send out radio impulses which register aircraft as 'blips' of light on the radar screens.



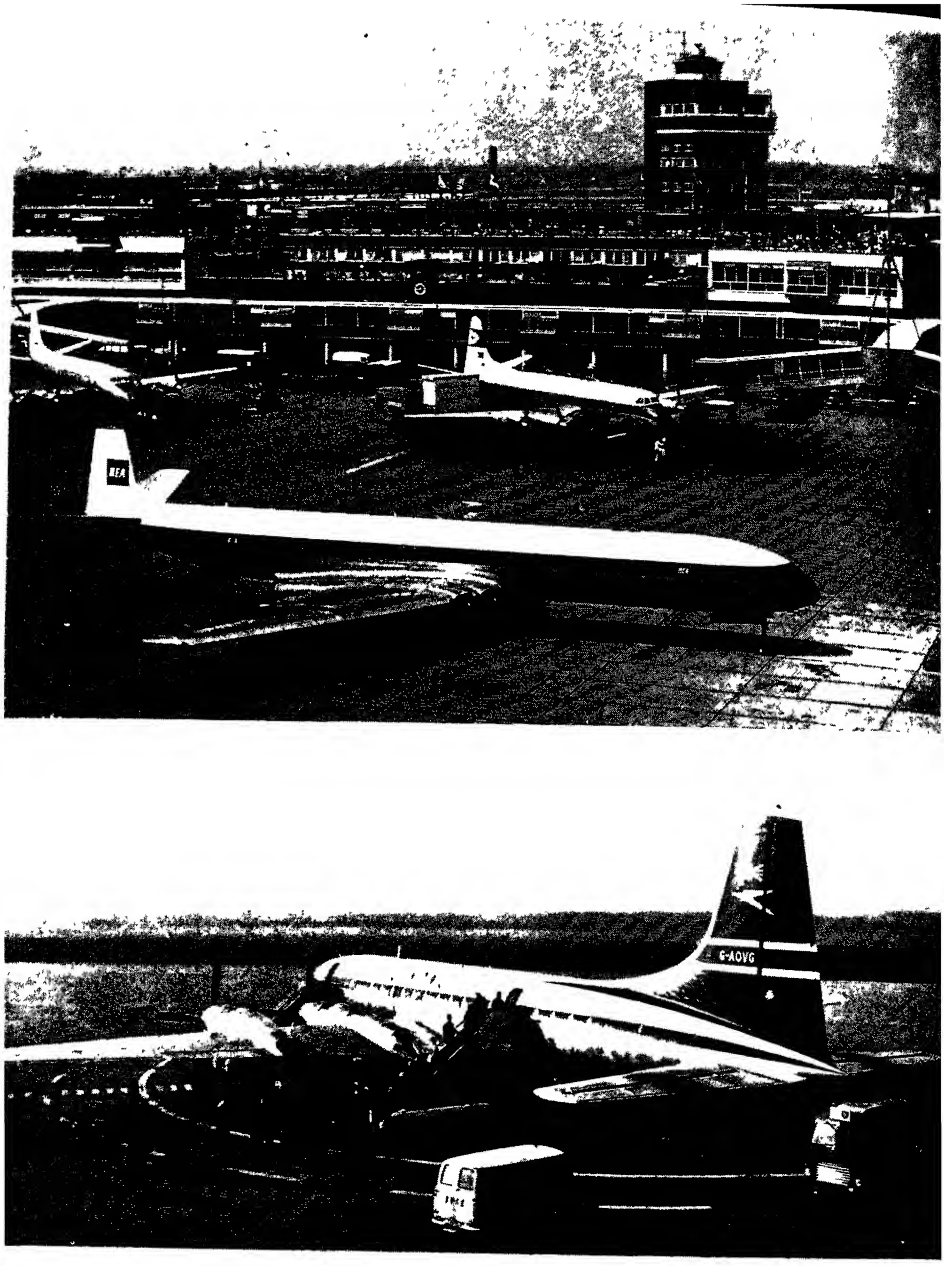


Night Landing.
Left: The pattern of the approach and runway lights seen by the pilot.
Below: A Boeing 707 jet airliner coming in.

Right: A captain and first officer being briefed before a flight. *Below:* Taking on fuel. It is piped under the runways from enormous storage tanks and transferred to the airliner in tankers.



Left: The long-haul passenger building, which includes a variety of shops. *Left, middle:* The final departure lounge.



Top: A B.E.A. Comet taxiing past the central terminal buildings. *Below:* Passengers boarding a B.O.A.C. jet-prop Britannia.

A pilot must master the numerous highly scientific instruments, and pass a very strict test known as an 'instrument rating'. Before he is posted to his first commercial airliner he will also be subjected to a series of flying tests in that particular type of aircraft.

His first posting may be as a junior pilot in one of the smaller airliners, and from that he will graduate by rank, seniority, and suitability to the command of larger airliners. The ambition of every pilot is, of course, to rise to the command of a jet airliner; but promotion to that high rank is attained only by long years of outstanding service.

Pilots and flight engineers, like athletes, keep up their training throughout their career. When a pilot transfers from one type of aircraft to another—from, say, a Britannia to a Comet—he undergoes another long course of instruction before taking over his new duties. Even the captains of the jet airliners who have risen to the top of their profession take regular courses in the simulators to keep themselves at the peak of efficiency. Pilots are licensed for a period of only six months at a time. At the end of that period they must pass more flying tests and another medical examination; and once a year they must also pass a further instrument rating. If they fail on any of these scores their licences become invalid until such time as they can satisfy the examiners. The same high standards are demanded of the crew as of the aircraft they fly.

Extremely high standards are also demanded of the cabin staff. The stewardesses—upon whose efficiency the passengers will base their judgment of the comfort of their journey—must be smart and of pleasing appearance, of warm and friendly personality, dignified, charming and tactful, keenly intelligent, and well educated, preferably with fluency in one or two foreign languages.

The stewardesses—as also the stewards—have many duties

and responsibilities. Before a flight they prepare the cabin and see that it is adequately provisioned with food, drink and cigarettes, newspapers and magazines, toilet requisites, linen and blankets, first-aid kit, and anything else that might be needed on the journey. During the journey they keep the cabin spick and span, serve the meals and drinks, and attend to the passengers' every comfort. The stewardesses devote particular attention to elderly women, invalids, and unaccompanied children, a large number of whom fly to all parts of the world to join their parents during school holidays. They do their best in every way to keep both the old and the young happy and prevent their feeling lonely or frightened. They are also attentive to the special needs and requests of the different nationalities of traveller. They are at beck and call to answer travel queries and solve currency problems. If anyone is taken ill an air stewardess will give the passenger whatever nursing attention may be required. Finally, if the airliner should run into a storm or encounter some other hazard likely to cause alarm, the senior stewardess or steward—having received warning of this from the flight deck on the internal telephone—must reassure the passengers on the public address system.

In the words of B.O.A.C., 'the stewardess must be a diplomat, ambassadress, psychologist, nurse, caterer, and bar-tender'. At their Cabin Services Training Unit at London Airport, carefully selected young men and women—including girls from India, Pakistan, Japan, Hong Kong, South America, and South Africa, who will serve on the air routes covering their respective countries—receive an intensive course of instruction in the many subjects they must master to 'win their wings'.

They learn about the various air routes, and the services and types of aircraft in operation on those routes; about the numerous forms and formalities to be dealt with on an international

journey; about travel regulations, international immigration, and such matters as time changes and currency conversion rates. The time changes in an airliner crossing the world at the speed of a bullet are dramatic, and could easily cause confusion in the service of meals. If meals were regulated by the local times of the countries along the route passengers might have breakfast almost immediately after dinner, or, alternatively, skip a meal and go without food for a very long stretch. To save the passengers this discomfort meals in the B.O.A.C. airliners are served at 'tummy time'—at intervals dictated by the needs of the stomach, regardless of the local time in the country over which the aircraft may be flying.

The preparation and service of meals for anything up to 150 passengers requires skilful organization. The stewards and stewardesses receive the greater part of their catering instruction —perhaps the most important part of their training—in a simulator representing the cabin of an airliner. Taking turns of duty, a team of students act as the cabin staff, while the rest of their colleagues recline in the seats and pose as the passengers. Under the close supervision of instructors, the team, subdividing the different tasks, heat the main course in the galley ovens, carve the poultry or joint, prepare the *hors d'œuvre*, salads, and sweets, mix drinks, and finally serve the meal. In addition to their instruction in the simulator, they have classroom tuition and study the procedure in the kitchens at London Airport.*

The stewardesses also receive an elementary medical and first-aid training—how to deal with simple illnesses, burns, fractures, and haemorrhages, and how to administer oxygen to a person suffering from a heart attack. They learn, too, 'survival drill'—how to help passengers in the event of an aircraft making a forced landing in the desert or 'ditching' in the sea.

The system at B.E.A.'s Cabin Services Training Unit follows

much the same pattern. At each centre discipline is extremely strict, men and women being severely reprimanded for any form of slovenliness or carelessness. And the same discipline is maintained throughout their career; if a stewardess neglects to wear her hat with her uniform out of doors, or has her tunic unbuttoned, she will be reprimanded most severely.

Several thousand men and women apply yearly to B.O.A.C. and B.E.A., but only a small percentage become stewards or stewardesses—so high are the standards demanded.

It is of the utmost importance for an air crew to work as a team, and to be on good and friendly relations with each other. Though the flight deck crew and the cabin staff are separated in the aircraft they are in constant communication. And when they land at some distant airport and hand over to another crew they will be thrown together socially and perhaps stay at the same hotel during the two or three days' break before taking over another airliner.

Any discord among the crew could impose a strain and endanger efficiency. But generally there is perfect harmony.

CHAPTER

7

Air Traffic Control

THE volume of air traffic between the major towns and cities of the world is now so great that all aircraft must comply with a strict highway code, framed by international agreement, to ensure safety and maintain a smooth and steady flow. Just as cars, lorries, and omnibuses drive along roads, and trains on railway lines, so airliners fly along clearly defined but invisible ten-mile-wide air corridors, or airways, in the sky. Moreover, they are not permitted to move along these airways at random, like motor traffic on the roads, but must fly in procession in positions dictated by the control centres along the different routes. To avoid any possibility of a collision, aircraft are separated from each other by height, time, and distance.

The heights—known as 'vertical separation'—are governed by the direction of the air routes. The 360 degrees of the compass are divided into two—East and West. Eastbound aircraft are required to fly at odd thousands of feet; while westbound aircraft are restricted to even thousands of feet. Thus, for example, an airliner bound for the Mediterranean might make the outward passage from London in the west division at a height of 8,000, 10,000, or 12,000 feet, and return in the east division at 7,000, 9,000, or 11,000 feet.

Vertical separation allows aircraft to head in opposite directions and to cross each other's tracks in complete safety. But this form of 'positioning' is not adequate by itself: aircraft flying in the same direction and at the same height must also be separated longitudinally, one behind the other, at a stated distance of miles or period of flying time, which may vary from five to a hundred miles, or from five to thirty minutes, according to the relative speeds of the airliners in the procession and the accuracy with which their positions are known. At busy periods the aircraft may be separated laterally as well, by the use of radar.

The traffic in these invisible airways is controlled, as already mentioned, by a chain of control centres stretching along the routes, whose highly trained teams watch the movements of the airliners on radar screens and 'signpost' the pilots to their next objective by ground-to-air electronic equipment. These controllers are the policemen of the sky, and the electronic equipment the traffic lights. But the control of air traffic is far more comprehensive than that of road traffic. As an airliner proceeds across the world, however long her journey, her position can be pin-pointed with complete accuracy at any time.

There are ten airways radiating to and from London Airport, and each bears a distinguishing name: Amber One, Amber Two, Red One, Green One, Blue Three, and so on. Some of these airways are reserved for outbound traffic, some for inbound traffic; and some are used for both. Amber One, for instance, is for southbound aircraft on the Paris and Rome routes, while Amber Two is for aircraft flying into London by these routes.

All aircraft—British and foreign, civil and military—flying on the airways into or over Britain come under the direction of the Scottish Air Traffic Control Centre, the Northern Air Traffic Control Centre, or the Southern Air Traffic Control Centre on crossing the seas surrounding the British Isles.

Scottish Air Traffic Control handle all traffic over Scotland and the Atlantic; Northern Air Traffic Control, whose headquarters are at Preston, handle traffic over the northern half of England; and Southern Air Traffic Control, which is situated in a corner of the airfield at London Airport but is not a department of the airport, are responsible for traffic over the southern half of England. Each of these centres receives the aircraft into the British airways system, directs it to a given point, and then hands it over to the control unit at the airport where it is to land; or, if it is on a non-stop flight over the country, directs it to the next foreign control centre.

Southern Air Traffic Control, who keep a radio and radar watch over all aircraft within a radius of about a hundred miles of London, receive the airliners bound for London Airport into the British network and then direct them to one of two 'holding points' some ten to fifteen miles distant from the airport. An airliner approaching from the south will be directed to Epsom, and an airliner from the north to Watford. At these points London Airport Approach Control take over and, also by means of radio and radar, direct the aircraft in orderly sequence and in a steady flow consistent with safety to the runway on which they are to land. Finally, after each aircraft has touched down, a ground controller—who is also operating in the glass penthouse at the top of the Control Tower with a view of sky, runways, and taxiways—takes over and directs the airliner to her appointed parking place on the apron by the passenger building.

The mass of electronic equipment required for these highly scientific operations is provided and maintained by another team of specialists, the Telecommunications Section, who are also housed in the Control Building.

Air Traffic Control are provided with six radio channels for the control and direction of the aircraft; and each channel is duplicated in such a manner that, if any part of the main

equipment should fail, the controller affected can pick up a special handset, similar to a telephone, and continue to 'work' the aircraft without interruption. The action of picking up the handset sets off alarms in the Telecommunications Equipment Room, thereby enabling the Duty Telecommunications Officer to arrange for the fault to be corrected with the minimum of delay. And, just in case the handset should also fail, a third line of reserve equipment is provided.

In the event of a failure in the main electricity supply complicated emergency machinery will automatically supply the transmitters and receivers with the necessary power. Safeguards against possible damage to the perimeter 'Control Circuit Cable'—another great risk—have been provided by an ingenious dual cable system, one part of which goes round the north and the other round the south of the airport. The main equipment is connected on the northern route, and the emergency equipment on the southern route. If one part of the cable should be cut, the transmitters will go through the undamaged section without a break in transmission.

Thirty-eight transmitters, seventeen of which go through the perimeter cable to Souther Air Traffic Control and twenty-one to the Control Tower of London Airport, are housed in a transmitting station in a remote corner of the airfield, where the massive aerials cannot obstruct aircraft landing or taking off. And in another remote corner is the receiving station, housing thirty-five Very High Frequency—VHF—receivers, seventeen of which go to Southern Air Traffic Control and eighteen to the Control Tower.

In addition to the ground-to-air and radar communications equipment required by the controllers for controlling the aircraft in the air, the Telecommunications Section also provide and maintain a mass of ground-to-ground equipment for controlling the movement of aircraft on the aprons and taxiways

and of land vehicles—police cars, fire tenders, and ambulances—on the tarmac.

Every item of equipment is inspected and serviced daily. This is such a vast undertaking that the service engineers and Duty Telecommunications Officers work by shifts day and night, cramming as much repair work as possible into the hours of darkness, when air activity is at its slackest. Meanwhile the numerous circuits in use by the various controllers are constantly being monitored by test equipment to ensure that the highest performance is achieved.

The Telecommunications Section also play an important part behind the scenes in the actual air operations.

Let us follow the procedure as an airliner from Rome flies into London by Amber Two Airway. As the aircraft crosses the French coast at Abbeville, leaving the French control area, the pilot establishes radio contact with the Southern Air Traffic Control Centre, introducing himself by the call sign in the international phonetic alphabet of his aeroplane. If, for example, the code letters of his aircraft are GAHOP, the pilot will introduce himself as 'Golf, Alpha, Hotel, Oscar, Papa'. On receipt of this call the controller responsible for this section of the airway, who has been watching the approach of GAHOP on his radar screen, gives the pilot any instructions that may be needed to keep him well clear of the many other aircraft in this busy airway, and, after checking his height and the time on his clock, sets him on course for the radio beacon at the 'holding point' at Epsom, where he hands over to London Airport Approach Control.

If traffic is heavy, or if there has been a delay through bad weather or some other cause, the pilot will be instructed to orbit his aircraft round the radio beacon until Approach Control are ready to receive him.

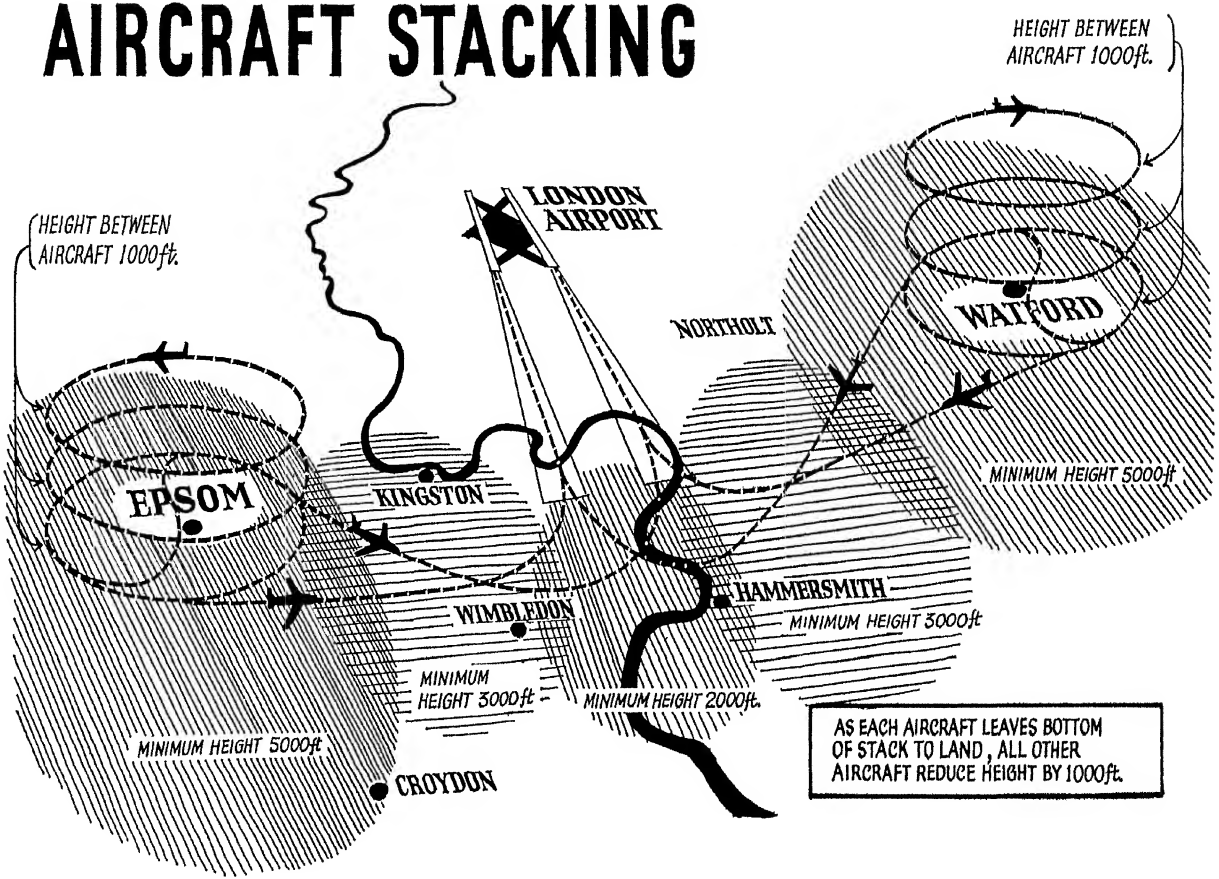
About sixty controllers are employed at London Airport, but

only some six or seven are on duty at a time; and, between them, they handle all the aircraft converging upon the airport, while at the same time directing others taking off—a task requiring superb organization and team work. They bring in the airliners in strict rotation. In normal conditions this operation, while requiring great skill, is comparatively straightforward; but at peak periods or in bad weather the controllers have to 'stack' the aircraft one above the other with a height separation between each of 1,000 feet, and then spiral them down by 1,000 feet at a time at various stages on to the approach to the runway. When an aircraft leaves the stack to land the rest in the procession, starting from the bottom, reduce height by 1,000 feet; the next one is then taken from the bottom of the stack, and the process is repeated.

As soon as Approach Control are ready to receive GAHOP, one of the radar controllers calls up the pilot by radio-telephone and gives him instructions about height, course, speed, and rate of descent. When the pilot has acknowledged these instructions, the controller switches over to another aircraft, and then to a third and a fourth. At the same time he watches the progress of all the aircraft he is handling, and of others he is about to take over, on his radar screen. Two 'scanners' on the airfield, revolving at the rate of ten revolutions a minute, send out radio impulses; and all aircraft within range register a 'blip' of light on the screen. As the scanners are constantly revolving these 'blips' shoot forward by a fraction of an inch with each revolution, thereby marking the progress and position of the aircraft. When traffic is heavy, the screen is speckled with 'blips'; but the controllers can identify the aircraft for which they are responsible without a moment's hesitation.

Though a controller may be handling as many as four aircraft simultaneously, he executes his difficult task with astonishing calmness, as though his was the easiest job imaginable. When

AIRCRAFT STACKING



GAHOP has reached a certain point on the radar screen, the controller may order the pilot to alter course or reduce height, or both; and from time to time he will issue further instructions concerning his descent.

Meanwhile, mechanically operated tape-recorders, controlled by the Telecommunications Section, are recording all the conversations between the controllers and the pilots of the arriving and departing aircraft in case, for some reason, as in the event of an accident, a report of the instructions issued should later be required. By means of ticker-tape machines, the Telecommunications Section are also supplying various departments of the airport with up-to-the-minute news of everything that is happening to facilitate their arrangements for the reception of each airliner on landing—a service known as the 'Telemove'.

The method of landing depends on the weather. If visibility is good, the controller will bring the aircraft on to a straight line approach to the runway; and the pilot will then descend the glide path and make his landing visually and without further assistance, though the controller will keep his eye on the radar screen and correct him if he drifts.

If visibility is poor or if low clouds obstruct vision, the descent will be made by means of either of two electronic aid systems: ILS (Instrument Landing System) or PAR (Precision Approach Radar), by which the aircraft can be 'talked-down'. When this system is used the pilot is handed over about seven miles from the runway to a controller with short-range precision radar who will assist or direct him down the glide path to an altitude of 150 feet at a point about 400 yards from the end of the runway.

In the case of ILS, the controller merely assists. At various points on the approach there are sensitive radio beacons; and, as the aircraft flies over these, two needles on instruments on

the flight deck register the displacement in degrees above or below the glide path, and the displacement to the right or left of the centre line of the runway, and the pilot makes what adjustments are necessary. The controller 'sequences' the aircraft on the ILS to bring them in in a continuous stream, and then monitors their descent on his radar screen and simply corrects the pilots when and if they make an error.

In the case of PAR, the controller directs the pilot down by radio telephone, using a radar screen scaled to show the exact height, distance from the runway, angle of descent, and drift. The screen of this complex machine is so clearly defined that even a layman can see at a glance the exact position of the aircraft as it 'blips' towards the runway.

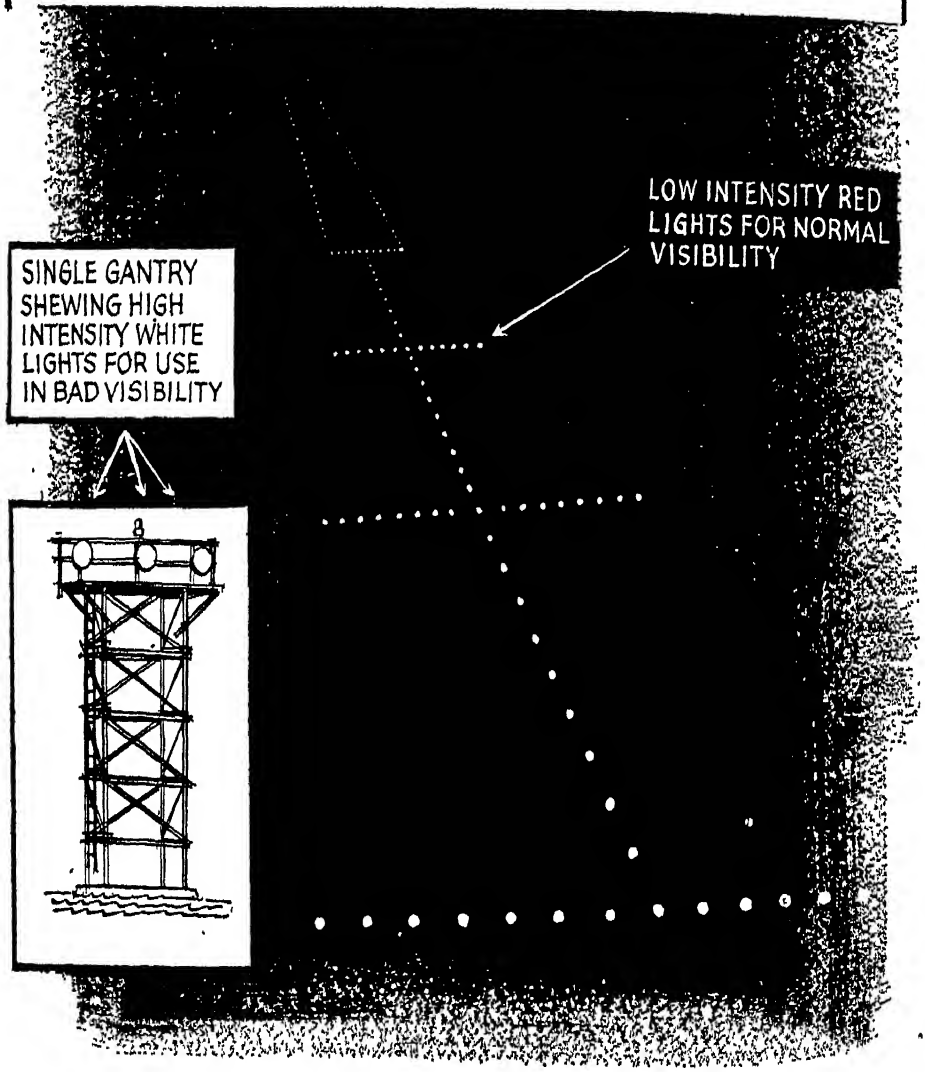
Whether he is using ILS or PAR, the pilot informs the controller the moment he can see the runway lights, and then completes the landing visually.

The runway lights at London Airport are arranged in a scientific pattern, with different colours and degrees of brilliance that can be varied to suit prevailing conditions of visibility; and this has proved so efficient that the system, original to London Airport, has since been adopted by most major airports throughout the world.

Lights can also be switched on along the taxiways to 'signpost' aircraft to their parking aprons, which may be more than a mile from the runway. When the airliner has landed and is clear of the runway, a ground controller, who can watch all the ground activities in every corner of the airfield on a surface radar, directs the pilot along the maze of taxiways by means of radio-telephone.

As the airliner taxies slowly towards her parking place, people from various departments of the airport, summoned by 'Telemove', converge upon the apron to receive her—marshallers, armed with indicators resembling table-tennis bats, who will

GLIDE PATH AND RUNWAY



guide the aircraft into its final parking position; men with the aircraft steps by which the passengers will alight; an officer and a stewardess to shepherd the passengers; baggage men, with vans, to unload the holds; freight men to deal with the cargo; caterers to collect the dirty linen, china, and glassware; a medical officer to inquire of the captain whether he has a clean bill of health; an Immigration officer to interrogate foreign travellers; and the Customs officials to give permission for the passengers to disembark, seal off the bonded stores, and rummage the airliner.

When an airliner takes off from London Airport she is also subject to rigid controls.

CHAPTER

8

A Flight

SOME time before a flight the airline company requests the Meteorological Office at London Airport to prepare weather reports and forecasts covering the route and to list suitable alternative aerodromes—'alternates'—to which the airliner could divert in the event of the airport of final destination closing down through a sudden adverse change in weather conditions.

On their arrival at London Airport the operating crew, having been warned for duty by post, are 'briefed' by their company about the general outline of the flight, and are given charts of the latest weather observations, including a carefully prepared forecast of any changes in weather that are likely to occur during the flight, showing the exact position where they may encounter turbulence or severe icing conditions, and the probable duration of these conditions. They also receive a forecast of the winds for the altitudes at which the aircraft will fly. Finally, the captain is given landing forecasts for his port of destination and perhaps three or four 'alternates' at widely separated points along the route. If, for example, the airliner were bound for Malta, the weather forecaster might recommend

diverting, should the need arise, to Nice, Elmas in Sardinia, Tripoli, or Rome.

The captain and his co-pilot and navigator then study their 'flight plan'. While they are engaged at this, the flight engineer goes out to the apron to make a mechanical inspection of the aircraft and to supervise the fuelling of the airliner. The fuel is stored on the edge of the airfield in enormous tanks like gasometers and is piped under the runways to underground tanks near the apron, whence it is transferred to the aircraft in tankers with a capacity of 10,000 gallons. The quantity of fuel an airliner carries is governed by the re-fuelling facilities along the route and by various other factors; but she must always carry sufficient to reach her destination and one 'alternate', with a surplus over and above these requirements for forty-five minutes' 'holding' before landing at her destination or 'alternate'.

Meanwhile the stewards and stewardesses go aboard and check the catering equipment, provisions, first-aid kit and lifejackets, and see that the cabin quarters are spick and span.

When the loading is completed, a 'load sheet' is prepared for the captain, showing how the load is distributed in the aircraft, the quantity of fuel, the maximum weight the airliner is permitted to lift and the actual weight she will lift at take-off, and also her probable landing weight, allowing for the fuel consumption on the journey.

This information is then incorporated in the flight plan, and this is submitted through the appropriate channels to Air Traffic Control for approval. If the airways are not too busy the plan will probably be approved without amendment; but if there is a risk of congestion at any point modifications of height or course may be demanded by a foreign control centre.

While his plan is being 'processed', the captain and his crew join the flight engineer, and check over the airliner to ensure

that everything is in perfect working order. The captain checks the control surfaces, going through all the movements of control while his co-pilot watches the mechanism to see that it operates in the correct way. The captain or first officer checks the radio equipment and the radio and radar electronic navigational instruments. And the flight engineer checks all the external workings. Though the aircraft has only just passed through the skilled hands of the maintenance engineers, the air crew take no risks: between them they may make as many as 150 or 200 checks.

Having satisfied himself about the efficiency of the aircraft, the captain attends to various formalities and collects his 'ship's papers'. The crew then finally board the airliner in readiness for flight. The passengers—who have been waiting in a lounge—are now escorted to the apron by a ground receptionist. As soon as they are aboard the doors of the aircraft are shut; and the senior stewardess tells them on the public address system the name of the captain, gives them a broad outline of the flight, naming the stopping points and the scheduled times of arrival at each, and issues a few safety instructions, the first of which is to refrain from smoking and to put on their safety belts at take-off. If there are many foreign travellers she may repeat all this in French and German.

The captain, meanwhile, calls up the Control Tower and requests permission to start up his engines. This granted, he makes a number of further checks that can only be executed with the engines running. The captain then contacts the ground controller for permission to taxi to the runway. While the airliner is taxiing, the ground controller in turn calls up the pilot and gives him his 'Airways Clearance'—the height and route to follow, which, if his flight plan has been accepted by the foreign control centres, will follow the pattern already arranged.

Suppose that the airliner is bound for Johannesburg by way

of Rome, the controller might say: 'You are cleared for London to Rome via Amber One Airway. Climb initially to 4,000 feet at Dunsfold (Sussex), and then climb under radar control to 18,000 feet and maintain that height.'

On reaching the end of the runway the captain makes final checks, obtains permission for take-off, enters the runway and, with everyone aboard safely strapped into his seat, opens the throttles and takes off. As soon as he is airborne the captain calls up Southern Air Traffic Control and reports the fact. The radar controller at Southern Air Traffic Control will either direct him on his ascent to 18,000 feet, as arranged, or, if the airway is clear of traffic, give him permission to make an unrestricted ascent, ordering the captain to report further when he has attained the prescribed height. Meanwhile, as soon as the aircraft has taken off, London Airport Air Traffic Control send the flight plan by teleprinter to all foreign control centres along its route.

As the airliner—now flown by the automatic pilot 'George'—crosses the English coast at Seaford, in Sussex, the captain signs out of London and signs in to the Paris control centre, informing them of the type and call sign of his aircraft and the details of his flight. He introduces himself in English because, by international agreement, English has been adopted as the universal language of air traffic controllers throughout the world.

The captain, having received any flying instructions that may be necessary, proceeds to the next control area, where he goes through the same procedure. And this is repeated at every control centre throughout the journey.

Navigating by means of airways charts, the basic blind-flying instruments, and the various electronic aids, the captain 'homes' 'George' on to the radio beacons, while his co-pilot monitors the instruments to see that the aircraft keeps to course. From time to time the automatic pilot may slide and require

adjustment; and there is always a faint possibility of 'George' suddenly failing. If that should happen the captain must immediately disconnect the automatic pilot and control the airliner by hand until the fault has been rectified. Meanwhile, the navigating officer plots the course and takes bearings; the flight engineer keeps a log of the flight and watches the fuel consumption; and one of the pilots maintains radio contact with the ground control centres and receives and transmits messages.

Cramped in their seats for anything up to ten hours, according to the length of the journey and the distance between stopping points, the crew attend to their respective duties with only an occasional short break to stretch their legs. From time to time the captain may go into the cabin to chat with the passengers and the stewards and stewardesses, and at such times the co-pilot takes over the controls: always one or other must be on duty. The crew eat their meals from trays on their knees and, though they may smoke, they will never have an alcoholic drink to stimulate themselves. They do not play cards and indulge in social amusements in the carefree manner reported in some newspapers. They seldom even talk. For most of the time they are in deep concentration, listening and watching, ever on the alert for anything that might go wrong.

On entering the control area of Rome, the first stopping-place, the captain calls up the controllers and asks for a descent clearance. The Rome controller responsible for the airliner's reception gives the pilot the course to follow and the points at which to reduce height. To land an aircraft is the most difficult branch of flying. On receipt of his landing instructions the captain, assisted by his co-pilot, makes a series of checks similar to those at take-off; and then, with the passengers and cabin staff again strapped into their seats, descends via the radio beacons—with or without the active assistance of the controller, according to visibility—and makes a visual landing.

At Rome Airport some of the passengers disembark and others take their place; and the airliner is refuelled and stocked with fresh provisions. During these activities the captain and his navigating officer visit the local Meteorological Office for the latest weather reports and forecasts, and then study and obtain approval of a flight plan to the next stopping-place, which on this particular journey will be at Khartoum. After a stop of perhaps forty-five minutes the airliner takes off on the next leg.

The passage from London to Rome was smooth, and the flight uneventful. On the leg from Rome to Khartoum, however, warnings of turbulence ahead appear on the radar screen. Immediately the captain reduces speed, disconnects the automatic pilot, and flies the aircraft manually. The warning is transmitted to the cabin staff, who at once request the passengers to put on their safety belts, informing them of the reason but assuring them, quite truthfully, that there is no cause for alarm.

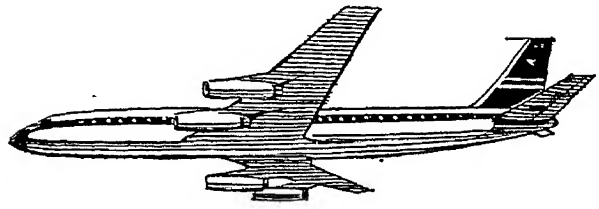
Thanks to his radar, the captain is able to avoid the storm area. The automatic pilot is brought back into operation. The aircraft is navigated across the African deserts, where there are few radio beacons, by compass and sextant and the long-distance radio aids; and eventually, without further adventure, the airliner lands in the intense heat of Khartoum.

Here the weary crew hand over to a fresh crew who had brought a previous airliner to Khartoum, and take a well-earned rest of perhaps forty-eight hours. When the next airliner operating on this route reaches Khartoum they return to duty and take the new arrival on the next leg of her journey, to Nairobi, where again they are relieved. And so, with periodic 'slipping' of crews, like runners in a relay race, each airliner is brought to Johannesburg, according to schedule and without undue strain on the crew.

At Johannesburg the airliner is inspected by engineers,

refuelled and revictualled—and then starts her return flight to London Airport.

As she re-enters the British control area by Amber Two Airway, Southern Air Traffic Control direct the pilot to the holding point at Epsom; and London Airport Air Traffic Control then take over and direct the landing operations, as described in Chapter Seven. Finally, when all the landing formalities have been completed, the airliner is towed by tractor to the maintenance workshops for an overhaul; and the crew return home until their next flight.



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